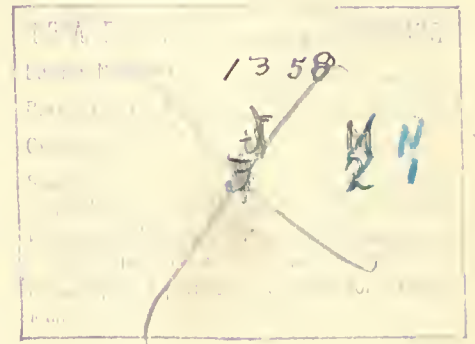
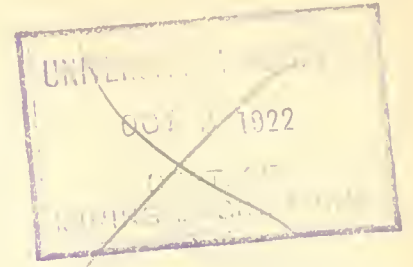


UNIV. OF
TORONTO
LIBRARY





Digitized by the Internet Archive
in 2008 with funding from
Microsoft Corporation

P
Leahurst
M.



(INDEX TO) VOLUME 122

Mining and Scientific Press

January to June 1921

172465
4/7/22

	Page		Page
A			
Abraham Lincoln	219	Baker, F. D., obituary	859
Addicks, L. Copper Refining, book review....	609	Balliet, Letson..... Oxy-acetylene welding and cutting	523
Aetna company, Hercules Powder Co. absorbs....	863	Ball-mill lining, steel rails as..... E. B. Morse....	465
Affinity of oil for mineral..... H. W. Reed....	640	Bancroft, W. D..... Applied Colloid Chemistry, book review	309
A. I. M. & M. E.....	645	Barnes-King Development Co.	424
Alaska, mining in 1920.....	163	Company report	572
Alaska Gold Mines Co..... R. B. Brinsmade....	149	Benefaction, a noble	114
Alaska Juneau Gold Mining Co., company report....	656	Benguet Consolidated Mining Co., company report....	572
Ditto	623	Benitez, F..... Rising tide of color....	351
Mill..... V. C. Clauson....	629	Bigness, the craze for mere..... Editorial....	664
Allen, A. W..... Book-reviewing....	708	Bin, louvred..... Newton L. Hall....	593
Ditto..... Chuquicamata enterprise....	779	Ditto..... W. M. Hutton....	323
Ditto..... Cutting metal with a steel disc....	487	Storage, with louvred hoppers.. Newton L. Hall....	88
Ditto..... Institute affairs....	281	Bingham Mines Co., company report.....	572
Ditto.... Recovery of Nitrate from Chilean Caliche, book review	732	Black Range tin district of New Mexico.....	
Ditto.... Regeneration of cyanide during precipitation	870	F. S. Naething....	557
Ditto..... Science and Life....	741	Black sand, gold in..... J. Gross....	869
All-round engineer	737	Ditto..... J. S. Taylor....	833
Almaden quicksilver mine in Spain... H. W. Gould....	567	Sand, recovery of gold from.....	
Aluminum	784	J. A. Davis and J. Gross....	504
During 1920	431	Blasting with liquid air.....	843
Amalgamating practice..... W. J. Williams....	592	Blue Horse mine	573
Amalgamation in stamp-mills... W. Motherwell....	383	Blue-sky laws	665
In the presence of oil..... L. C. W. Graefe....	593	Book-reviewing..... A. W. Allen....	708
American Engineering Council	573	Ditto..... F. H. Mason....	833
American industry in the War..... Editorial....	554	Borcherdt, W. O..... Institute affairs....	217
American Mining Congress	436	Borzynski, F..... Arizona Silver Mines mill....	717
American Smelting & Refining Co..... 377, 396,	608	Botsford, R. S..... Placer mining in Russia....	671
Company report	608	Bramble, C. A..... Prospecting in Canada....	183
American Trona Corporation..... C. G. Fowler....	743	Braschi, V. M..... Origin of Spanish names....	805
American Zinc, Lead & Smelting Co., company report..	608	Brazil, high-level diamond deposits of.....	
Amigo	41	A. M. Pontie....	397
Anaconda Copper Mining Co.....	411	Brinsmade, R. B..... Alaska Gold Mines Co....	149
Another apex decision	663	Britannia Mining & Smelting Co.....	468
Antimony	456	British Columbia, mining during 1920.....	61
Apex decision, another..... Editorial....	663	Broad-lode hypothesis	37
Applied Colloid Chemistry, book review.....		Ditto..... A. G. Ologist....	79
W. D. Bancroft....	309	Ditto..... L. S. Ropes....	284
Are drill-bits magnetic?	335	Ditto..... F. L. Sizer....	150
Argentina, manganese mining in	389	Broken Hill Proprietary Co., Ltd., report.....	311
Arizona Silver Mines mill..... F. Borzynski....	717	Strike	22
Artificial Light, book review..... M. Luckiesh....	852	Brooks, Lyman H., Jr..... Cooke City and the New	
A. S. & R. and smelter contracts.....	721	World mining district	682
Reduces expenses	611	Brunton, David W.: Consulting engineer, an interview	
Asbestos, South African	844	T. A. Rickard....	745
Assay-furnace, new type of oil-fired... E. K. Craig....	184	Ditto..... History of the Huelva district....	130
Assessment work	865	Brunton sampler	752
Ditto..... W. K. Whitmore....	704	Bunker Hill & Sullivan Mining & Concentrating Co.,	
Work, suspension of..... E. Hedburg....	871	company report	850
Austin, L. S..... Science and Life....	741	Smelter	42, 47
Automotive Ignition Systems, book review.....		Bureau of Mines, professional advice from the.....	
E. L. Consoliver and G. I. Mitchell....	609	Editorial....	801
B			
Bain, H. Foster..... Editorial....	38	Burgess, J. A.... Valuing partly exhausted mines....	703
Ditto..... Mining as a business....	641	Burnham, M. H.....	486
Bain's Mr., appointment	38	Business expansion abroad	518
		Butson, H..... The strike at Tonopah....	833
		Butte & Superior Mining Co., company report.....	850
		Butte mine operators, ultimatum to unions.....	431

	Page		Page		
C		Jim Butler Tonopah Mining Co.	607		
Cahill, W. E. Electric-furnace practice at Treadwell	535	Judge Mining & Smelting Co.	818		
California's metal output in 1920	97	Kennecott Copper Corporation	818		
Callahan, J. A. obituary	859	Lake Shore Mines, Ltd.	478		
Callahan Zinc-Lead Co. company report	608	La Rose Mines, Ltd.	572		
Calumet & Hecla	431, 433	McIntyre Porcupine Mines, Ltd.	311		
Company report	607	Miami Copper Co.	731		
Camp Bird and Manufacture, book review	609	Mt. Blachett Tin Mining Co.	607		
Camp Bird, Ltd. company report	731	Mt. Lyell Mining & Railway Co., Ltd.	312		
Cans, Elementary and Advanced, book review	686	Mt. Morgan Gold Mining Co., Ltd.	312		
Canada, prospecting in	183	Mysore Gold Mining Co.	607		
Canadian Consolidated Mining & Smelting Co.	436	Natomas Mines of California	572		
Canadian metal and mineral production	395	Nipissing Mining Co.	656		
Mining in 1920	197	North Broken Hill, Ltd.	312		
Carman, E. S. Foundry Molding Machines and Pattern Equipment, book review	686	North Butte Mining Co.	731		
Carnegie, Andrew, Autobiography of, book review	34	North Star Mines Co.	607		
Cause and control of lead poisoning	427	Old Dominion Co.	607		
Central Eureka Mining Co. company report	818	Oriental Consolidated Mining Co.	478		
Champion Reef Gold Mining Co. of India, company report	607	Phelps Dodge Corporation	818		
Chemical Analysis of Special Steels, book review	109	Portland Gold Mining Co.	572		
Chief Consolidated Mining Co. company report	311	Ray Consolidated Copper Co.	850		
Shaft	741	Santa Gertrudis Co., Ltd.	731		
Chile Exploration Co.	779	Shattuck Arizona Copper Co.	607		
Chilean nitrate and synthetic compounds	452	Silver King Consolidated Mining Co. of Utah	607		
China, mint for	292	St. Joseph Lead Co.	478		
Silver prices and famine in	284	Superior & Boston Copper Co.	478, 608		
Chlorination of natural gas	430	Tennessee Copper Co.	850		
Chaquicamatin enterprise	779, 835	Tomboy Gold Mines Co., Ltd.	311		
Clauson, V. C. Alaska Juneau mill	629	Tonopah Belmont Development Co.	731		
Clinton, G. Conductivity of Solutions, book review	610	Tonopah Extension Mining Co.	818		
Coal mines, electricity in	228	U. S. Smelting, Refining & Mining Co.	731		
Storage of	131	United Eastern Mining Co.	818		
Coal Washing, book review	309	Utah Consolidated Mining Co.	608		
Coalite	849	Utah Copper Co.	608, 850		
Cobalt	644	Victoria Copper Mining Co.	572		
Coghill, W. H. Educating v. drop-forging	160	Yukon Gold Co.	312, 731		
Collins, G. E. Institute expenditure	218	Compressed Air, book review	571		
Ditto	871	Compressed Air Plant, book review	109		
Colombia, treaty with	555	Conditions in Mexico	485		
Colombian treaty	640	Conductivity of Solutions, book review	610		
Colorado, low-grade and complex ores in	263	Congo, Belgian, gold mining at Kilo	606		
Colorado School of Mines	541	Conkling v. Silver King Coalition	349		
Ditto	247, 552	Consolidated Arizona Smelting Co.	432		
Ditto	413	Consoliver, E. L. and G. I. Mitchell	Automotive		
Ditto	773	Ignition Systems, book review	609		
Coloring of glass	806	Consumption of reagents used in flotation	262		
Ditto	872	Convention, reporting a	588		
Commodities, prices of	477, 655, 798	Cock, Alfred A. Defence of Minerals Separation	89		
Comodoro Rivadavia oilfield	726	Cocke, D. W., obituary	795		
Company meeting	699	Cooke City and the New World mining district	682		
Company reports:		Lyman H. Brooks, Jr.	348		
Alaska Juneau Gold Mining Co.	656	Copper	14		
American Smelting & Refining Co.	608	Future of	Edwin C. Holden	98	
American Zinc, Lead & Smelting Co.	608	In 1920	287		
Anaconda Copper Mining Co.	850	Metal from the consumer's point of view	872		
Barnes-King Development Co.	572	Mining in Newfoundland	431		
Benguet Consolidated Mining Co.	572	Production, curtailment of	609		
Bingham Mines Co.	572	Refining, book review	757		
Broken Hill Proprietary Co., Ltd.	311	Selling agencies	887		
Bunker Hill & Sullivan Mining & Concentrating Co.	850	World's production of	609		
Butte & Superior Mining Co.	850	Copper Refining, book review	117		
Callahan Zinc-Lead Co.	608	Corning, F. G.	North Star Mines	78	
Calumet & Hecla Mining Co.	607	Cost of Mining	J. R. Finlay	623	
Camp Bird, Ltd.	731	Cost of the War	660		
Central Eureka Mining Co.	818	Cotton rope for transmission	495		
Champion Reef Gold Mining Co. of India	607	Cottrell processes	Field		
Chief Consolidated Mining Co.	311	Cox, G. H., C. L. Dake, and G. A. Muhlenthal	610		
Daly West Mining Co.	818	Methods in Petroleum Geology, book review	184		
Davis-Daly Copper Co.	312	Craig, E. K.	New type of oil-fired assay-furnace	883	
De Beers Consolidated Mines, Ltd.	478	Crampton, T. H. M.	Silver Horn district, near Pioche, Nevada	664	
El Oro Mining & Railway Co.	478	Craze for mere bigness	Editorial	570	
Franklin Mining Co.	656	Creative Chemistry, book review	E. E. Slosson	589	
Goldfield Consolidated Mines Co.	572	Credulity and the nitrate deposits	Editorial	512	
Hecla Mining Co.	572	Crismon, G. W., obituary	Prospecting	425	
Hedley Gold Mining Co., Ltd.	818	Crocker, W.	Oxy-acetylene welding and cutting	486	
Hollinger Consolidated Gold Mines Co.	572	Cunningham, T. W.	This World of Ours, book review	441, 479	
Inspiration Consolidated Copper Co.	731	Curle, J. H.	Cutting metal with a steel disc	A. W. Allen	810
		Ditto	Cyanide notes	Algernon Del Mar	436
			Solutions, de-aeration of	H. A. White	286
			Vats, repairing		

	Page		Page
D		Editorial:	
Daly West Mining Co., company report.....	518	Oxy-acetylene welding and cutting.....	411
Davis, C. W..... Radio-activity and some practical		Panama tolls dispute	380
applications	229	Portland convention	517
Davis, F. P..... Prospecting.....	740	Position of silver	37
Davis, J. A and J. Gross..... Recovery of gold from		Power projects	77
black sand	564	Presidency and journalism	279
Davis-Daly Copper Co., report	312	Price of silver	279
De-aeration of cyanide solutions..... H. A. White....	430	Professional advice from the Bureau of Mines.....	801
Dean, R. S..... Theory of flotation.....	291	Prospecting	800
Deane, E. G..... Nevada Consolidated.....	413	Quiet times	867
De Beers Consolidated Mines, Ltd.....	478	Railroad problem	771
Deep mining on the Rand.....	335	Reparations	179
Defence of Minerals Separation..... Alfred A. Cook....	89	Reporting a convention	588
Definition of 'concentrator'..... Engineer.....	352	Revision of the mining law.....	830
De Kalb, Courtenay..... Metallurgical methods at		Shut-down	484
Rio Tinto	185	Silver and the Pittman Act.....	443
Ditto..... Pyrite in the Huelva district, Spain....	125	Silver in prehistoric times.....	446
Del Mar, Algernon..... Cyanide notes.....	810	Simplicity in metallurgical planning.....	831
Ditto	384	Taxation of mines	317
Denny, G. A.	398	Transactions of the Institute.....	411, 587
Destructible power resources..... Editorial.....	700	Transportation by motor-truck	280
Development of vibrating screen.....		Treaty with Colombia	555
B. A. Mitchell and G. B. Rosenblatt.....	419	Valuation of mines.....	379, 486
Diamond deposits of Brazil, high-level.....		Vanderlip concession	76
A. M. Pontie.....	397	Ventilation and miners' phthisis.....	770
Diamonds, slump in	611	Zinc industry	519
Domestic and foreign supply of nitrate.. Editorial....	249	Educating v. drop-forging..... W. H. Coghill....	160
Drake, Francis..... Coloring of glass.....	806	Ditto..... L. O. Howard.....	285
Dredging in the Klondike.....	494	Education for miners	772
Drill-steel	488	Of engineers	318
Drumheller, D. M., Jr..... Tidewater mine.....	423	Ditto	521
		Of a mining engineer..... W. S. Weeks.....	321
E		Eilers v. Guggenheims.. 7, 63, 166, 199, 226, 264, 377,	396
Easton, Stanly A.	865	Ditto..... Editorial..... 1, 2, 443,	517
Economic aspect of economic geology.....		Electric Furnace, book review..... H. Moissan.....	609
C. A. Porter.....	161	Furnace practice at Treadwell.... W. E. Cahill....	535
Interests	41	Shovels	660
Situation in Mexico	266	Electric Welding, book review..... E. Vail.....	732
Editorial:		Electricity in coal mines.....	228
Alaska Juneau	623	Electrolytic Deposition and Hydrometallurgy of Zinc,	
American industry in the War.....	554	book review..... O. C. Ralston....	309
An all-round engineer	737	Zinc refining..... O. C. Ralston....	352
Another apex decision	663	Electrolytic Zinc Co.....	767
Bain's appointment	38	Elementary facts about oil..... P. B. McDonald....	286
Blue-sky laws	665	Ellis, C., and J. V. Meigs..... Gasoline and Other	
Broad-lode hypothesis	37	Motor Fuels, book review.....	732
Business expansion abroad	518	El Oro Mining & Railway Co.....	478
Colorado School of Mines.....	247, 552	Emminger, W. G..... Sampling in a mill....	152
Company meeting	699	Emmons, W. H. Geology of Petroleum, book review....	609
Conditions in Mexico	485	Enberg, J. O. Technical practice in the Philippines....	670
Conkling v. Silver King Coalition.....	349	Engineer, an all-round	737
Copper	348	Education of a mining..... W. S. Weeks.....	321
Cost of mining	78	Engineering Council of Utah.....	399
Cost of the War	623	Engineering Draughtsman, book review.....	
Craze for mere bigness.....	664	E. Rowarth.....	109
Credulity and the nitrate deposits.....	589	Engineering Electricity, book review.....	
Destructible power resources	700	R. G. Hudson.....	33
Domestic and foreign supply of nitrate.....	249	Engineering Foundation..... Alfred D. Flinn....	86
Education for miners	772	Engineers, education of	318
Education of engineers	318	Ditto	521
Eilers v Guggenheims..... 1, 2, 443,	517	A. Locke.....	41
Flotation litigation	115	Prospecting.....	41
Future of mining	444	Explosives, handling of	676
German reparations	700	Permissible	96
Guggenheims and the smelting industry.....	179	Export Packing, book review..... C. C. Martin....	609
Hold fast and look forward.....	3	Ex-soldiers and prospecting..... D. C. Simpson....	117
How many hours	147	Eye, C. M..... Packing for export....	255
Industrial research	349		
Institute affairs	214, 622	F	
Institute as a publisher	116	Fairchild, D. H..... Colorado School of Mines....	413
Institute magazine	736	Fairhaven silver-lead district, Alaska.....	
Institute membership and professional status.....	248	L. A. Levensaler.....	195
Institute transactions	411, 587	Fernie, W., obituary	795
International finance	216	Field Methods in Petroleum Geology, book review....	
Irish question	146	G. H. Cox, C. L. Dake, and G. A. Muihlenburg....	610
Japanese problem	832	Filter, an ingenious..... A. T. Fry.....	266
Lead salts and plagiarism	215	Finance, international	216
Licensing of engineers	319	Financial Engineering, book review. O. B. Goldman....	658
Mexican affairs	830	Finch, J. K..... Topographic Maps and Sketch	
Mining of quicksilver	553	Mapping, book review.....	33
Mr. Bain's appointment	38	Finlay, J. R..... Cost of Mining, book review....	109
New methods in geology	588	Fire hazards at mines.....	191
Nice point	319	Fitch, Walter, Jr., Co. Chief Consolidated shaft....	741
Noble benefaction	114	Flin Flon mine	541
Outlook for domestic silver.....	867	Flinn, Alfred D..... Engineering Foundation....	86

	Page		Page
K		Metallurgical methods at Rio Tinto	
Kantishna mining district, Alaska....J. A. Haney....	881	Courtenay De Kalb....	185
Keith, Frank Allen, obituary.....	826	Ditto.....L. S. Ropes....	638
Kennecott Copper Corporation, company report.....	818	Ditto.....G. D. Van Arsdale....	451
King, A.....Lead salts in cyanide practice....	803	Operations of the Judge Mining & Smelting Co....	
Klondike, dredging in the.....	494	A. B. Parsons....	153
Knapp, S. A.....Prospecting....	742	Planning, simplicity in.....Editorial....	831
Knox, H. H.....Institute affairs....	323	Method of calculating the average value of placer	
Koering process.....T. F. O'Brien....	523	ground.....Jansbi Sen....	704
L		Of recording geology in development work.....	
Labor economics.....H. L. Turner....	413	C. E. Wuench....	233
Labor's Crisis, book review..Sigmund Mendelsohn....	309	Mexican affairs.....Editorial....	830
Lake Shore Mines, Ltd.....	478	Metal production.....	360
Lancaster, A., obituary.....	795	Oil production.....	467
La Rose Mines, Ltd., company report.....	572	Mexican Properties and Securities, Handbook of, book	
Lawrence, B. B., obituary.....	208	review.....	109
Laws affecting oil exploitation in Mexico.....		Mexico, conditions in.....Editorial....	485
C. A. Grabill....	635	Economic situation in.....	266
Lead, book review.....J. A. Smythe....	33	Mining opportunities in northern.....	707
Lead mining in Western Australia.....	196	Reconstruction in.....	501
Poisoning.....	162	Miami Copper Co., company report.....	731
Poisoning, cause and control of.....		Miller, Hugo W.....Silver as money....	39
W. S. Slemmons....	427	Mine car compressor, portable.....	660
Salts and plagiarism.....Editorial....	215	Car recorder, automatic.....	390
Salts in the cyanidation of silver ores.....		Timbers, treatment of.....	336
R. W. Perry....	221	Mineral resources of Queensland.....	462
Salts in cyanide practice.....A. King....	803	Minerals Separation Co.....	377
World's production of.....	886	Defence.....Alfred A. Cook....	89
Lena Goldfields.....	392	Patents.....Gilbert H. Montague....	5
Lenskoie Gold Mining Co.....	394	Miners, education for.....Editorial....	772
Levensaler, L. A.....Fairhaven silver-lead district,		Mines, taxation of.....Editorial....	317
Alaska.....	195	Valuation of.....Editorial....	379, 486
Lewis, W. V.....Prospecting....	739	Mining as a business.....H. F. Bain....	641
Leyner drill.....G. E. Collins....	871	Congress Journal.....	866
Licensing of engineers.....	297	Engineer, education of.....W. S. Weeks....	321
Ditto.....Editorial....	319	Engineer, status as a.....F. C. Smith....	251
Lincoln, Abraham.....	219	Engineers and the Institute..P. B. McDonald....	254
Liquid air, blasting with.....	843	Future of.....Editorial....	444
Locke, A.....Education of engineers....	521	In Alaska in 1920.....	163
Loco-tractor system.....	442, 461	In British Columbia during 1920.....	61
London silver market, the ways of the.....		In Dutch Guiana.....A. R. Rogers....	151, 383
R. P. Skinner....	719	Ditto.....T. F. Van Wagenen....	5, 283, 488
Loomis, Horace.....Mining opportunities in		Law, proposed revision of.....	845
northern Mexico.....	707	Law revision.....	819
Loring, W. J.....McFadden Bill....	251	Ditto.....Editorial....	830
Louvred bin.....N. L. Hall....	88, 593	Litigation and common sense..A. B. Parsons....	813
Ditto.....W. M. Hutton....	323	Manual and Year Book, 1921, book review.....	609
Lowery, R. T., obituary.....	795	Of quicksilver.....Editorial....	553
Low-grade and complex ores in Colorado.....	263	On the Mother Lode of California.....	
Luckiesh, M.....Artificial Light, book review....	852	A. E. Rau Roesler....	807
Ludlum, A. C.....Russian placer mining....	806	Opportunities in northern Mexico.....	
Lunt, H. F.....An interesting silver deposit....	670	Horace Loomis....	707
Lynn Big Six Mining Co.....	409	Mining Congress Journal.....	866
M		Mining Manual and Year Book, 1921, book review.....	609
MacDougall, F. H.....Thermodynamics and Chemistry,		Mint for China.....	292
book review.....	732	Mitchell, B. A., and G. B. Rosenblatt...Development of	
Magnetic, are drill-bits.....	335	vibrating screen.....	419
Malaya tin experts.....	285	Modern Welding Methods, book review. V. W. Page....	33
Tin in.....	13	Moisson H.....Electric Furnace, book review....	609
Tin production.....	884	Molybdenum mine, the R. & S.....	132
Manganese mining in Argentina.....	389	Monypenny, J. H. G.....Unstainable steel....	463
Martin, C. C.....Export Packing, book review....	609	Montague, Gilbert H.....Minerals Separation patents....	5
Mason, F. H.....Book-reviewing....	833	Moonshine power.....R. H. Sanders....	834
Ditto.....Chilean nitrate and synthetic		Morris, E.....Single-jack in Western Australia....	152
compounds.....	452	Mother Lode of California, mining on the.....	
McCornick, W. S., obituary.....	764	A. E. Rau Roesler....	807
McDonald, P. B.....Elementary facts about oil....	236	Motherwell, W.....Amalgamation in stamp-mills....	383
Ditto.....Mining engineers and the Institute....	254	Motor-truck, transportation by.....Editorial....	280
Ditto.....Slosson's Creative Chemistry....	708	Mount Bischoff Tin Mining Co., company report.....	607
McFadden Bill.....W. J. Loring....	251	Mount Lyell Mining & Railway Co., company report....	312
McIntyre Porcupine Mines, Ltd., company report.....	311	Mount Morgan Gold Mining Co., Ltd., company report....	312
McKay, R. F.....Theory of Machines, book review....	33	Mountain Copper Co.....	433
Mechanical World Electrical Pocket Book for 1921,		Moyer, J. A.....Gasoline Automobiles, book review....	852
book review.....	686	Ditto, and C. H. Sampson.....Practical Trade	
Mechanical World Year Book for 1921, book review....	658	Mathematics, book review.....	33
Meigs, J. V., and C. Ellis.....Gasoline and Other		Mt. Bischoff Tin Mining Co., company report.....	607
Motor Fuels, book review.....	732	Mysore Gold Mining Co., company report.....	607
Mendelsohn, S.....Labor's Crisis, book review....	309	N	
Mercury, tariff on.....	431	Naething, F. S.....Black Range tin district of	
Merrick, M.....Hoover and single-jacking....	80	New Mexico.....	557
Metal market.....31, 73, 107, 141, 175, 209, 243,		Natomas Mines of California, company report.....	572
275, 307, 345, 375, 407, 438, 475, 513, 549, 582,		Natural gas, chlorination of.....	430
619, 654, 695, 730, 765, 796, 827, 861, 894		Need of quantitative methods in applied geology....	
		C. H. White....	601
		Nest, E. M.....Prospecting....	706

	Page
Nevada Consolidated .. E. G. Dean ..	413
Nevada Consolidated Copper Co. .. A. H. Parsons ..	325, 709
Nevada metal production for 1920 ..	200
New concrete shaft of the Chief Consolidated Mining Co. .. A. H. Parsons ..	595
Methods in geology .. Editorial ..	588
Surface plant for the United Verde Copper Co. .. L. A. Parsons ..	873
Type of oil-fired assay furnace .. E. K. Craig ..	184
New Cornelia Copper Co. ..	506
New Idria Co., tariff on mercury bought by ..	431
Newfoundland copper mining in .. T. E. Wells ..	872
Nice point .. Editorial ..	319
Nickel production .. W. A. Flynn ..	488
New Stone Age, book review .. H. E. Howe ..	851
Nipissing Mining Co., company report ..	656
Nissen, P. N. ..	483
Nitrate Chilean, and synthetic compounds .. F. H. Mason ..	452
Deposits, credulity and the .. Editorial ..	589
Domestic and foreign supply .. Editorial ..	249
Supply .. M. W. von Bernewitz ..	451
Noble benefaction .. Editorial ..	114
Norman, S. .. Protection for the promoter ..	673
North Broken Hill, Ltd., company report ..	312
North Butte Mining Co., company report ..	731
North Star Mines .. F. G. Corning ..	117
Company report ..	607
Northern Ore Co. ..	16
Noves, W. A. .. Organic Chemistry for the Laboratory, book review ..	609

O

O'Boyle, F. .. Prospecting ..	740
O'Brien, T. F. .. Koeling process ..	523
Oil exploitation in Mexico, laws affecting .. C. A. Grabill ..	635
Old Dominion Co., company report ..	607
Ologist, A. G. .. Broad-lode hypothesis ..	79
Ore testing at Golden, Colorado ..	194
Organic Chemistry for the Laboratory, book review .. W. A. Noyes ..	609
Organic troubles .. C. T. Hutchinson ..	259
Oriental Consolidated Mining Co. ..	478
Origin of Spanish names .. V. M. Braschi ..	805
Orsk Goldfields ..	392, 395
O'Shaughnessy, E. .. Intimate Pages of Mexican History, book review ..	685
Outlook for domestic silver .. Editorial ..	867
Oxy-acetylene welding and cutting .. L. Ballet ..	523
Ditto .. Editorial ..	411
Welding and cutting at Anaconda .. T. W. Cunningham ..	425

P

Pacific Gas & Electric Co. ..	865
Packing for export .. C. M. Eye ..	255
Padgett, F. W., and W. A. Hamor .. Technical Examination of Crude Petroleum, book review ..	109
Page, V. W. .. Modern Welding Methods, book review ..	33
Panama tolls .. H. W. Reed ..	521
Ditto .. F. F. Sharpless ..	521
Tolls dispute .. Editorial ..	380
Paper plants, conversion of gold mills into ..	647
Parsons, A. B. .. Institute affairs ..	282
Ditto .. Metallurgical operations of the Judge Mining & Smelting Co. ..	153
Ditto .. Mining litigation and common sense ..	813
Ditto, Nevada Consolidated Copper Co. ..	325, 525, 709
Ditto .. New concrete shaft of the Chief Consolidated Mining Co. ..	595
Ditto .. Sampling at the Garfield smelter ..	17
Parsons, L. A. .. Steam-shovel operations at the United Verde mine ..	453
Pearse, A. L. .. Refining of oil-shale ..	151
Peele, R. .. Compressed Air Plant, book review ..	109
Penzer, N. M. .. Tin Resources of the British Empire, book review ..	852
Perini, S. L. .. Prospecting ..	804
Permissible explosives ..	96
Perret, L. A. ..	378
Ditto .. Russian placer mining ..	391, 415, 457
Perry, R. W. .. Lead salts in the cyanidation of silver ores ..	221

Peterson flotation cell ..	424
Petroleum consumption ..	399
Phthisis, ventilation and miners' .. Editorial ..	770
Phelps Dodge Corporation, company report ..	818
Philippines, technical practice in .. J. O. Enberg ..	670
Pittman Act .. C. A. Porter ..	594
Act, silver and .. Editorial ..	443
Piz Piz gold district, Nicaragua .. R. Hawhurst, Jr. ..	353
Placer ground, method of calculating the average value of .. Janshi Sen ..	704
Mining in Russia .. R. S. Hotford ..	671
Ditto .. G. L. Holmes ..	592
Ditto .. A. C. Ludlum ..	806
Ditto .. L. A. Perret ..	391, 415, 457
Ditto .. S. J. Spenk ..	834
Plagiarism, lead salts and .. Editorial ..	215
Pentle, A. M. .. High-level diamond deposits of Brazil ..	397
Poor zones and enrichments .. M. W. von Bernewitz ..	6
Zones, rich and .. W. E. Simpson ..	118
Porter, C. A. .. Economic aspect of economic geology ..	161
Portland Canal district, geology of .. Victor H. Wilhelm ..	95
Portland convention .. Editorial ..	517
Portland Gold Mining Co., company report ..	572
Position of silver .. Editorial ..	37
Powdered Coal as a Fuel, book review .. C. F. Herington ..	33
Power from low-grade fuels .. M. W. von Bernewitz ..	41
Projects .. Editorial ..	77
Resources, destructible .. Editorial ..	700
Practical Trade Mathematics, book review .. J. A. Moyer and C. H. Sampson ..	33
Practice of Lubrication, book review .. T. C. Thompson ..	34
Present status of litigation .. T. A. Rickard ..	119
Presidency and journalism .. Editorial ..	279
Price of silver .. Editorial ..	279
Prices of commodities ..	477, 655, 798
Procaska, E. .. Coal Washing, book review ..	309
Producer-gas .. G. M. S. Tait ..	252
Ditto .. M. W. von Bernewitz ..	384
Professional advice from the Bureau of Mines .. Editorial ..	801
Promoter, protection for .. S. Norman ..	673
Proposed revision of the mining law ..	845
Prospecting .. A. Prospector ..	218
Ditto .. W. Crocker ..	774
Ditto .. F. P. Davis ..	746
Ditto .. Editorial ..	800
Ditto .. R. S. Everitt ..	41
Ditto .. S. A. Knapp ..	742
Ditto .. W. V. Lewis ..	739
Ditto .. E. M. Nest ..	706
Ditto .. F. O'Boyle ..	746
Ditto .. S. L. Perini ..	804
Ditto .. D. C. Simpson ..	803
Ditto .. E. C. Watson ..	743
Ditto .. E. M. West ..	706
Ditto .. F. W. Wright ..	707
Ex-soldiers .. D. C. Simpson ..	117
In Canada .. C. A. Bramble ..	183
Past and future .. T. A. Rickard ..	559
Protection for the promoter .. S. Norman ..	673
Pumping by Compressed Air, book review .. E. M. Ivens ..	33
Purlington, C. W. ..	393, 394
Pyrite in the Huelva district, Spain .. Courtenay De Kalb ..	125, 487

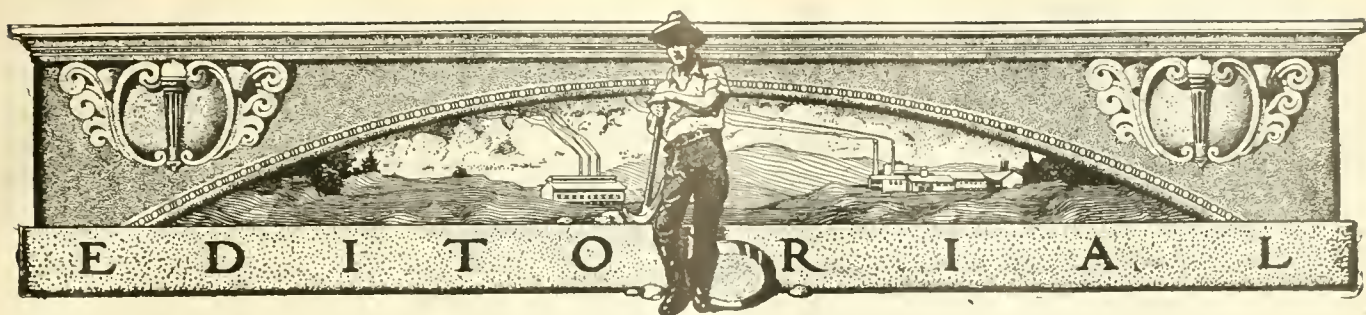
Q

Queensland, mineral resources of ..	462
Quicksilver mine, Almaden, in Spain .. H. W. Gould ..	567
Mining of .. Editorial ..	553
Ore, sampling and estimation of .. C. M. Schuette ..	293
Tariff on ..	431
Quiet times .. Editorial ..	867

R

R. & S. molybdenum mine ..	132
Radio-activity and some practical applications .. C. W. Davis ..	229
Radium ..	880
Railroad problem .. Editorial ..	771

	Page		Page
Ralston, O. C. Electrolytic Deposition and Hydrometallurgy of Zinc, book review.	309	Siberian mining.	449, 450
Ditto. Electrolytic zinc refining.	352	Silver and the Pittman Act. Editorial.	443
Rand dividends.	377	As money. Hugo W. Miller.	39
Mining costs.	878	Deposit, an interesting. H. F. Lunt.	670
Ray Consolidated Copper Co.	466	In India. H. Gulick.	593
Company report.	850	In pre-historic times. Editorial.	446
Ray Hercules Copper Co.	432	Market, ways of the London. R. P. Skinner.	719
Read, T. T. Silver prices and famine in China.	284	Outlook for domestic. Editorial.	867
Ditto. Transactions of the Institute.	592	Position of. Editorial.	37
Reconstruction in Mexico.	501	Price of. Editorial.	279
Recovery of gold from black sand.	504	Prices and famine in China. T. T. Read.	284
J. A. Davis and J. Gross.	504	Silver Horn district, near Picche, Nevada.	
Recovery of Nitrate from Chilean Caliche, book review.		T. H. M. Crampton.	883
A. W. Allen.	732	Silver King Consolidated Mining Co. of Utah, company report.	607
Reed, H. W. Affinity of oil for mineral.	640	Silver State Chemical Co.	399
Ditto. Panama tolls.	521	Simons, T. Compressed Air, book review.	571
Refining of oil-shale. A. L. Pearse.	151	Simplicity in metallurgical planning. Editorial.	831
Regeneration of cyanide during precipitation.		Simpson, D. C. Ex-soldiers and prospecting.	117
A. W. Allen.	870	Ditto. Prospecting.	803
Repairing iron vats.	286	Simpson, W. E. Rich and poor zones.	118
Reparations. Editorial.	179	Single-jack in Western Australia. E. Morris.	152
Reporting a convention. Editorial.	588	Sintering process, Greenawalt. W. E. Greenawalt.	81
Research, industrial. Editorial.	349	Sizer, F. L. Broad-lode hypothesis.	150
Residue re-treatment.	22	Ditto. Institute affairs.	324
Revision of the mining law. Editorial.	830	Skinner, R. P. The ways of the London silver market.	719
Rice, John A. Valuing partly exhausted mines.	667	Slemmons, W. S. Cause and control of lead poisoning.	427
Rich and poor zones. W. E. Simpson.	118	Slosson, E. E. Creative Chemistry, book review.	570
Rickard, T. A. Bunker Hill smelter.	42, 47	Slosson's Creative Chemistry. P. B. McDonald.	707
Ditto. David W. Brunton: consulting engineer, an interview.	745	Smith, F. C. Status as a mining engineer.	251
Ditto. Present status of flotation litigation.	119	Smith, R. E.	393
Ditto. Prospecting, past and future.	559	Smythe, J. A. Lead, book review.	33
Rio Tinto, metallurgical methods at.		Soddy, F. Science and Life, book review.	657
Ditto. Courtenay De Kalb.	185	Spanish names, origin of. V. M. Braschi.	805
Ditto. G. D. Van Arsdale.	451	Spassky copper mine.	295
Rising tide of color. F. Benitez.	351	Speak, S. J. Russian placer mining.	834
Rock temperatures in South Africa.	426	St. Joseph Lead Co.	400, 478
Rod-mill. Algernon Del Mar.	384	Standardization of mining.	13
Roesler, A. E. Rau. Mining on the Mother Lode of California.	807	Of mining and milling materials. A. B. Foote.	739
Rogers, A. R. Mining in Dutch Guiana.	151, 383	Ditto. G. F. Hickok.	487
Rollsright car-tipple.	895	Ditto. E. A. Wraight.	361
Ropes, L. S. Broad-lode hypothesis.	284	Status as a mining engineer. F. C. Smith.	251
Ditto. Metallurgical methods at Rio Tinto.	638	Steam-shovel operations at United Verde mine.	
Ditto. Valuing partly-exhausted mines.	667	L. A. Parsons.	447, 448, 453
Rosenblatt, G. B. Underground haulage for mines of moderate size.	785	Steel companies' earnings.	399
Ditto and B. A. Mitchell. Development of vibrating screen.	419	Rails as ball-mill lining. E. B. Morse.	465
Rowarth, E. Engineering Draughtsman, book review.	109	Stevens, B. International Association of Silver Producers.	253
Russia, trade with.	538	Stockton Coal Co.	410
Russian placer mining. R. S. Botsford.	671	Storage bin with louvred hoppers. Newton L. Hall.	88
Ditto. G. L. Holmes.	592	Of coal.	131
Ditto. A. C. Ludlum.	806	Strike at Tonopah. H. Butson.	833
Ditto. L. A. Perret.	391, 415, 457	Superior & Boston Copper Co., company report.	478, 608
Ditto. S. J. Speak.	834	Suspension of assessment work. E. Hedburg.	871
S		T	
Sampling and estimation of quicksilver ore.		Taconite treatment.	455
C. N. Schuette.	293	Taft, W. H.	505
At the Garfield smelter. A. B. Parsons.	17	Tait, G. M. S. Producer-gas.	252
In a mill. W. G. Emminger.	152	Taxation of mines. Editorial.	317
In gold bullion.	422	Taylor, J. S. Gold in black sand.	833
Sampson, C. H., and J. A. Moyer. Practical Trade Mathematics, book review.	33	Teaching engineering students to write. H. A. Watt.	192
Sanders, R. H. Moonshine power.	834	Technical Examination of Crude Petroleum, book review. W. A. Hamor and F. W. Padgett.	109
Santa Gertrudis Co., Ltd., company report.	731	Technical Methods of Analysis, book review.	
Savage, A. C., obituary.	694	R. C. Griffin.	732
Schuette, C. N. Sampling and estimation of quicksilver ore.	293	Technical practice in the Philippines. J. O. Enberg.	670
A. W. Allen.	741	Tennessee Copper Co., company report.	850
Ditto. L. S. Austin.	741	Theory of flotation. R. S. Dean.	291
Ditto, book review. F. Soddy.	657	Theory of Machines, book reviews. R. F. McKay.	33
Sen, Janshi. Methods of calculating the average value of placer ground.	704	Thermodynamics and Chemistry, book review.	
Sharpless, F. F. Panama tolls.	521	F. H. MacDougall.	732
Shasta Zinc & Copper Co.	853	This World of Ours, book review. J. H. Curle.	441, 479
Shattuck-Arizona Copper Co.	432	Thompson, A. P.	379
Company report.	607	Thompson, T. C. Practice of Lubrication, book review.	34
Shockley, W. H. Coloring of glass.	872	Tidewater mine. D. M. Drumbheller, Jr.	423
Ditto. Gold-digging ants.	706	Tin in Malaya.	13
Ditto. Washington B. Vanderlip.	79	Tin Resources of the British Empire, book review.	
Shut-down. Editorial.	484	N. M. Penzer.	852
Of copper mines.	505	Tintie Standard Mining Co.	890
		Temboy Gold Mines Co., Ltd., company report.	311
		Tem Reed Gold Mines v. United Eastern Co.	677
		Tenopah Belmont Development Co., company report.	731



T. A. RICKARD, Editor

AID to the mining industry of Mexico is promised by the government of President Obregon. It is proposed to reduce Federal taxes and freight-rates on the railroads, and also to annul laws restricting the importation of such materials as steel, powder, acids, and tools. The President has been in consultation with the Governors of the mining States, including Guanajuato, Zacatecas, and Durango, for the purpose of devising means to assist the operation of mines.

GOOD SENSE was shown by the employees of the Granby Consolidated company at Anyox by their voting, in the proportion of 750 to 175, to accept the new scale of wages offered by the company. The manager, Mr. H. S. Munroe, told the men definitely that the company could not continue operations on the present scale of wages, having regard to the fall in the price of copper, and would have to close the plant unless the proposed reduction, of 75 cents per shift, was accepted, this reduction to be revised three months hence. Both management and men have shown moderation and, we repeat, good sense.

BEFORE international commerce can be restored to anything like a healthy condition it will be necessary to stabilize international exchange. That can best be done if the League of Nations, now in session at Geneva, is successful in its efforts. The world is called upon to choose between solvency and armaments; eleven out of twelve European countries showed a deficit last year, but in most cases disarmament would convert the deficit into a surplus. Of the world's total expenditure, 20% goes to preparation for war, and the burden is not only exhausting the European nations economically but it threatens to destroy them politically.

PROPOSALS are heard for dropping sundry taxes that operate unfairly, or that are uneconomic in their incidence. The excess-profit tax is one, the zone-rate of postage is another. We would like to see the check-tax revived because it is one that would be paid by those who can afford to do so; but the best expedient undoubtedly is the sales-tax, which at 2% is estimated to yield \$3,000,000,000 per annum, and therefore would go far to produce the revenue needed. Another good tax would be one on applicants for Federal appointments, at the rate, say, of 2½% on the salary of the desired office.

This would save a lot of time and trouble at Washington, besides conserving paper, of which there is such lamentable wastage at this time.

SENATOR HENDERSON has introduced a bill for amending Section 2324, Revised Statutes, dealing with assessment work on mining claims, so that the final date may be changed from January 1 to July 1 each year. This is commendable because the present date falls in the very dead of winter, and, as many of our mining districts are in the mountains, the season coincides with heavy snow and other inclement conditions prejudicial to the performance of the annual labor required by law. Assessment work is usually, and not unwisely, postponed as much as possible; for a man does not spend his money until he has to. We hope Senator Henderson's successor or his present colleague from Nevada will continue the effort to legislate in this direction.

REFERRING to the petition of Mr. Eilers, reproduced elsewhere in this issue, it is curious what blunders of phraseology are made by lawyers. For example, mention is made of "Messrs. Daniel, Murry, Isaacs, Sol and Simon Guggenheim", and one asks naturally whether the fourth in order was named Sol or Solomon, but four paragraphs later reference is made to "the said Solomon R. Guggenheim". There is no "said" Solomon R., although there is a Sol—and long may he shine! Again, later, a paragraph begins with a reference to "their policy of gambling in metals", which they "carried further". There has been no previous mention of "gambling", so it is not clear how it could be carried "further". Obviously, in the previous paragraph the lawyer should have characterized the method, there described, as 'gambling', by saying, for example, that the policy of selling for future delivery involved transactions that were essentially of a gambling character. The punctuation of these legal documents is lamentable; it would be better if commas were omitted altogether, as is done by some attorneys, rather than use them indiscriminately. For example: "The staggering losses to the Company to which I have made reference herein". Does he make reference to the 'company' or to the 'losses'? Again: "When I found myself and my fellow directors, who had actively attempted to assist me in opposing the Messrs. Guggenheim, eliminated from the directorate of the Company". All his fellow-directors were not "eliminated".

inated", only those that had been backing him in his opposition to the Guggenheims, the comma before 'who' should be deleted.

THIS country is not threatened with a panic, but we are in the midst of a period of financial and industrial depression, how long and how serious this period will be depends upon the level-headedness of the American people. "This is the time for sanity and courage, not for pessimism and doubt," declared Mr. Frank B. Anderson, president of the Bank of California, in a notable address delivered recently before the Commonwealth Club in San Francisco. Mr. Anderson analyzed the events leading to the present abnormal condition of business; he suggested four fundamental things that must be accomplished before the necessary readjustment will be possible. First, the existing Federal revenue laws must be repealed; these he characterized as destructive, unfair, and unsound. They discount initiative, tax fictitious profits, put a premium on waste and extravagance, and penalize economy. Second, the great undigested mass of Liberty bonds must be absorbed by legitimate investors; in other words, these bonds must find their way into safe-deposit boxes instead of being perpetually pledged and re-pledged as security for bank loans. One-third of the Federal Reserve loans today are based on Liberty bonds. Third, labor must be liquidated; which is another way of saying wages must come down. The fair thing would be to delay the reduction in wages until retail prices have been lowered; but the sequence will probably be reversed. Fourth, ways must be devised for financing the purchase of our excess products by the rest of the world, which needs them so badly but which cannot cope with the handicap of unfavorable rates of exchange. To these might be added the need for restoring the normal volume of buying on the part of the American people. Following a period of unprecedented extravagance, which lasted for several years, we suddenly went to the opposite extreme six months ago. A revulsion against \$100 suits, \$20 shoes, and \$5 neckties swept like a wave over the country and the consumer stopped buying. Thrift is always beneficial, but any radical change is likely to be attended with disaster. The various phases of business in the country are too intricately interlocked to permit extreme stagnation in the retail markets without a sympathetic reaction in industry and finance. What is needed is confidence on the part of the consumer that he is getting fair treatment from the retailer. Today he is distrustful; his attitude will be changed only by convincing action on the part of the merchants. All these things, except the last, are in the process of solution today. We agree with Mr. Anderson when he says that "patience and the same common sense that has pulled us through emergencies in the past will do so again. We have bountiful harvests, we have 105 million people to be fed, clothed, and amused; we are under-built, not over-built as we have been when most of the past booms burst. There is a world of work to be done and therefore I believe that we shall escape the long period of depression that usually succeeds such periods of inflation."

Eilers v. Guggenheims

In this issue we publish the text, *verbatim et literatim*, of the petition filed by Mr. Karl Eilers for a writ of mandamus calling upon the American Smelting & Refining Company to give him access to the company's stock register. The reason, which is plainly stated, for these proceedings is to enable Mr. Eilers to address himself to the stockholders, said to number 19,000, for the purpose of requesting their support in an effort to oust the Guggenheim family from the control of the company's administration and more particularly to eject Mr. Simon Guggenheim from the presidency of the company. In justification of his action, and of the further action he intends to take, Mr. Eilers gives facts, with arguments based upon those facts. The affair will interest our readers keenly, for it affects the mining industry in a large way, the administration of the affairs of such a corporation as the American Smelting & Refining Company being a matter of direct concern to those engaged in mining operations all over the country. We confess at once that our sympathy goes to Mr. Eilers, because we know him to be a professional man of high character and an operating metallurgist of the first rank. Moreover, he speaks, as it were, for his father, the late Anton Eilers, the pioneer of lead smelting in the West and one of the worthies of American mining history, a man of the highest type. Mr. Karl Eilers has long been identified with the Smelting company and we find it not at all difficult to believe that he has a genuine pride in its past and feels a genuine anxiety over its future. In short, we assume that he is prompted by worthy motives. It is fair to remark that his continued holding of such a large block of stock shows his loyalty to the company. Whether the writ of mandamus will enable Mr. Eilers to obtain the names and addresses needed by him for his appeal to the stockholders, we do not know. Possibly, by legal devices, the Guggenheims may balk his efforts long enough to enable them to obtain all the proxies required to re-elect themselves at the next annual meeting in April, but it is quite certain that the exposure of the management by Mr. Eilers' petition will have decisive results in other ways. In the first place, it marks a deep cleavage across the administration. Mr. Judd Stewart died not long ago, and we regret to recall the fact. Likewise Mr. Brush is no more. It has been known for some time that the directorate was splitting into two factions, but so long as the trouble was not ventilated publicly there was a chance of its being adjusted. Obviously it has gone so far now that those in control will have to give an account of themselves. It should be possible for the stockholders to assert themselves by appointing a committee of inquiry, but probably it will be difficult to do so if the Guggenheims oppose such an investigation. The old question arises, are directors to be regarded as trustees for the stockholders or are they only privileged speculators? Next, is the president of a company the spokesman for the directorate or is he a high cockalorum without accountability to his fellow-directors? It is evident that the story of the Smelting company is like

that of other creations of high finance. First a group of clever men organize a private business, which, as soon as it becomes successful, is turned into a public corporation, on a capitalization that discounts future expansion; the stock goes to a premium; the insiders sell out, but remain in office and retain handsome official salaries, long after they have ceased to give the service for which the salary is supposed to compensate. The Guggenheims started with 300,000 shares, or nearly half the entire common stock of the company. By April 1919, according to the statement made by Mr. Eilers, they had sold all except 100 shares of their common stock, and owned only 201 shares of the preferred stock. The entire board of directors, outside Mr. Eilers and his family, held only 700 shares of common stock, out of 650,000. Now the question arises, whether the directors of a company should be chosen for their stockholdings or for their ability as managers and their worthiness as trustees? It is to be presumed that so long as the Guggenheim family owned nearly half the property, as expressed in shares, they were entitled to a predominant voice in the management, particularly if their dominance synchronized with the distribution of satisfactory dividends, but when they sold their stock and their decreased shareholdings synchronized with diminished dividends, it became proper to question the advisability of a change in the administration of the enterprise. To put it bluntly, would Mr. Simon Guggenheim be engaged as the chief of the enterprise on account of his knowledge of mining and metallurgy, or of the business relating thereto, on his own merits as a technician and financier? That is a debatable point. Similarly most of the brothers and nephews might not be picked by other people to manage a mining and smelting business of large dimensions. Mr. Daniel Guggenheim, before he started his various speculations outside the Smelting company, was a man whose ability and acumen would be sought and would be engaged at a large salary, but it is evident, from the data given by Mr. Eilers, that the Guggenheims have treated the Smelting company as a perquisite of the family. This might not have proved too expensive to the shareholders, even at the rate of a total of \$500,000 per Guggenheim in ten years, but the gambling in copper, up and down, selling first for future delivery on a rising market and then holding copper on a falling market, has entailed losses that are much less agreeable, particularly as they are mixed inextricably with private interests in copper-mining companies. The other transactions in which the duties of the Guggenheims as directors of the Smelting company clashed with their private speculations and promotions are likewise manifestations of a kind of dealing that unfortunately is all too common in 'big business' circles, and it deserves to be pilloried. We appreciate the humorous side of the letter to Mr. Simon, retorting upon the latter's demand for the resignation of Mr. Eilers by insisting upon the resignation of the ex-Senator, who, by the way, acquired that senatorship by means not altogether according to Hoyle, however conventional in political circles in Colorado. Our readers will be able to form their own opinion of the merits of the quarrel

by reading Mr. Eilers' petition; when the Guggenheims make a reply, we shall publish it promptly, but we presume that their legal response will be a demurrer and a general denial. The test may come at the annual meeting of stockholders in April. Meanwhile we hope, in the interest of clean business in mining, that Mr. Eilers will succeed in getting at the stock register, so as to make an appeal to his fellow-sufferers and bring the issue to a public test.

Hold Fast and Look Forward

These are days that call for a steadfast mind and a virile optimism. Only now are we feeling the effects of the readjustments that were bound to come as the aftermath of a great war. The liquidation of commodities, securities, and labor was inevitable. In other countries, more deeply engaged in the bloody struggle of the calamitous years, the sequel to the Armistice of 1918 was a realization of lives lost, of finances depleted, and of government disorganized. We missed the acuter phases of the immediate post-war period; indeed, our loss of manhood in battle was relatively small, our gain in wealth was enormous, and our government, even if it did not suit everybody, was never shaken. Even after our share of fighting came to an end we failed to face the inevitable reorganization of industry, which had been stimulated unhealthfully by the manufacture of everything needed, and some things not needed, for the campaign overseas. Wages continued abnormally high, the prices of commodities were maintained on a false level, the extravagance of our people as a whole resembled an orgy. We are now in the cold gray dawn of the morning after. The conditions obtaining during the last three years could not last, because they were unreal. During the last quarter of 1920 the play of economic forces became insistent and prices generally suffered a nearly perpendicular drop, causing the appearance of a collapse of the market for textiles, foodstuffs, and metals. Wages remained firm until the very end of the year, when notices of severe reduction began to be issued on every side. Turning to the industry in which our readers, with us, are particularly interested, it is a fact, of course, that many mines had to be closed down on account of the decreased price of the metals, notably copper and lead. No disposition was shown on the part of labor to accept lower wages, as might be thought logical in deference to the fact that wages had been advanced when metal prices were rising; therefore the owners of mines were compelled in many cases to suspend operations. The unwillingness of labor to meet the conditions caused by the depression in the metal market is intelligible on account of the fact that the high cost of living had not been abated to any considerable degree, the drop in wholesale prices having been disregarded by the middlemen and retailers. In short, profiteering, that is, inexcusably high prices prompted solely by greed, was still dominant. The consequence was a widespread feeling that the bottom had dropped out of everything and that a calamity was impending. This feeling was not shared by those who

were well informed and capable of intelligent retrospection. Some of our friends, scared by conditions that they ought to have anticipated, reminded us of an inland child that sees the tide go out, not understanding its meaning. The child sees the waters withdraw from the beach, the rocks lured, the seaweed exposed, the boats stranded, and thereupon imagines that the ocean is about to dry up. The ebb and flow of the tide is a phenomenon no more natural than the rise and fall of markets, which are as obedient to the law of supply and demand as are the waters of the sea to the moon's behest. The world of economics swings and balances on a thin edge between 'must have' and 'must sell'. A man needs not to be a Methuselah to recall similar apparently catastrophic, but actually normal, ups and downs in the prices of metals, for example. What if silver is selling at 60 cents, copper at 13, and lead at 5; did not silver sell for 46 cents in 1915, did not copper sell at 11 cents in 1911, and did not lead sell at 3 cents in 1908? There have been depressions before, many times, and they have been followed by revivals, have they not? The tide comes back as surely as it goes out, shall we imitate the ignorant child and boo-hoo because our little sand-castle is left high and dry for a while?

Why should we be depressed unduly, much less despair, at the temporary recession of our tide of industrial activity? There is much to encourage us at this time. During the past fiscal year our foreign trade reached a total value of over 13 billion dollars, of which \$5,238,621,000 represented imports and \$7,950,429,000 exports, our commerce overseas being three billion dollars more than it was in 1919; moreover, five billions of it was carried in American vessels as against only \$368,359,000 carried in American bottoms during the year before the War. Our population, according to the completed census, is 117 millions, in itself a splendid market for our products and a huge reservoir of productive energy if properly organized. There is nothing unexpected or mysterious in the present condition of business; it has been foretold repeatedly by intelligent observers; we had no reason to expect to escape a time of liquidation in commodities, securities, and labor; we can thank our stars and the Federal Reserve system that the unpleasant process can be effected nowadays without a financial panic. The unpleasantness of the process of deflation is due mainly to the effort of some elements in the community to escape their part of the readjustment, and the rebound to a healthy recovery will be delayed until they are compelled to participate. The business of this country since the beginning of the War has been on a false basis of profit rather than of cost, whereas sound business is built upon economy. Our part of the world, like the other part upon which some of us look with a much too complacent pity, needs to work harder and save more. Only honest labor and decent thrift can establish individual and national self-respect. The Government must set the example; it is idle for statesmen to preach economy so long as they condone Federal extravagance; they must make an earnest and concerted effort to stop

the reckless expenditure of Government bureaus and departments, such as is exhibited by duplication of offices, multiplication of office holders, and unending petty expenditures that in the aggregate run into millions daily.

Another change that we need is a broader outlook. It is absurd to expect to export without importing; it is ridiculous to anticipate a generous market for our own products while planning to erect a high wall of tariffs; it is foolish to expect to be prosperous while chuckling over the insolvency of our customers. The parochial view must be replaced by a world view. Too many of our men of business continue to show symptoms of shell-shock; they are so afraid of what the laborer and the tax gatherer will take from them that they are unable to look abroad and realize the extraordinary opportunities offered to American capital and American initiative in foreign lands. At a time when foreign exchange favors exploitation abroad and acts as a most effective check to importation from abroad they strive apparently to shut themselves within their own borders and wish to regard the United States as an island in space, instead of seeing that it is today the senior partner of all the nations and the big brother of all the peoples.

The members of the mining profession hardly need to be lectured in this way; they have a mind of wider angle; they have traveled too much to be attracted by the ideas that cling to the parish pump; they realize the opportunity offered to our country in world-wide mining enterprise in consequence of the position of the United States as the creditor nation of the present epoch. Let us take a hint from the example of the English, who, when their country occupied a position of similar financial vantage, went forth into distant lands and sowed the seeds of a great commerce by starting mining exploration and exploitation in every corner of the earth. We have the capital to do it and the engineers that know how to do it. And now is the appointed time; for now is the time to buy prospects cheaply, especially in Mexico, where order has been restored and a new government welcomes foreign participation in genuine development. The prices of the metals are low, and therefore mines are cheaper than they will be when the metal market recovers. It is sure to recover soon, for civilization is built on a structure of metal and the growth of material progress involves a constantly increasing consumption of iron and copper, of lead and zinc, besides a score of minor metallie elements. For a while production is reduced on account of the high cost of everything involved in the production, but the incorrigible ratio of supply and demand will assert itself in due course, and then will come a revival of mining from its temporary slump. Financial arrangements for giving credit to European buyers are inevitable; they are already under way. There exists a great lack of metals in the countries devastated by war. Our own domestic consumption never stops, but increases progressively. There will be a good market for the miner's harvest from underground. Cheer up, gentlemen of the mining industry. The year will end much better than it begins.

DISCUSSION



Minerals Separation Patents

The Editor:

Sir—Two points in your admirable editorial of December 4, 1920, entitled 'The Flotation Conference', may possibly mislead some readers who for years have relied upon your information and guidance in all matters relating to flotation and Minerals Separation:

First: Referring to the exchange of telegrams between Mr. Cook, counsel for Minerals Separation North American Corporation, and Mr. Ballot, its president, on the question whether Minerals Separation claim that "if a licensee uses first patent in suit after its expiration in 1923, and operation thereafter does not come under other patents, he must continue to pay royalties to us", to which Mr. Ballot replied that "we do not claim payment of royalty on the patent in suit or on any other patent at time of expiration, but we do claim royalty for any other unexpired patents", you state: "Mr. Montague expressed gratification at Mr. Ballot's telegram, characterizing it as 'magnificent' and more than justifying all the efforts made by the American Mining Congress, in behalf of flotation users". Most of your readers caught the significance of your quotation marks around the word "magnificent", and everyone who heard me at the Conference will recall that I promptly called Mr. Cook's attention to Article 5 of Minerals Separation's standard license agreement which provides that "the licensees shall not directly or indirectly during the continuance of this license nor at any time after the termination thereof, dispute or object to the validity of the letters patent within this license, or the novelty or utility of the inventions specified therein", and that I then told the Conference—notwithstanding Mr. Cook's interruptions, protesting that there had been enough talk from lawyers—that any licensee who used after 1923 the process of the first patent in suit would be obliged, because of this provision in his license agreement, to accept Minerals Separation's opinion as to whether such process was covered by any of the scores of other "letters patent within this license", and would be prevented from ever "disputing or objecting" to Minerals Separation's opinion on this subject, and that until Minerals Separation rescinded Article 5, Mr. Ballot's apparent concession was not "magnificent", nor even any concession at all; to all of which Mr. Cook replied that he would not answer that question now. Without this colloquy—which you allude to merely as "a further altercation between the lawyers"—some of your readers may miss the significance of your quotation marks around "magnificent", and may impute to me an

attitude regarding Mr. Ballot's telegram which is exactly opposite to my true attitude, and may fail to appreciate that I am exactly in accord with your subsequent remark to the Conference to the effect that "as to the 'magnificence' of Mr. Ballot's telegram, he (Mr. Rickard) thought that interpretation ridiculous".

Second: You state: "It needed no lawyer to see that the Minerals Separation company could not collect royalty on a patent after it had expired." Lest some of your readers assume that this is a truism, and that Minerals Separation concedes it, and that no one anywhere denies it, and that any licensee of Minerals Separation may confidently act upon it, I must inform you that, except for the anti-trust laws and the Federal Trade Commission law, there is nothing whatever to prevent the owner of a patented process from requiring an operator desiring to use the patented process during the 17-year period of the patent to pay royalties for 25 years; or 50 years, or 75 years, or, like Minerals Separation, for 17 years from the date of any patent it may acquire in the future, which practically means eternity. The reason is that such a contract, harsh though it be, if voluntarily entered into by any operator of sound mind is, except for the anti-trust laws and the Federal Trade Commission law, a valid contract, absolutely enforceable in law. This is exactly what Minerals Separation in its standard license agreement has actually done, and manifestly intends to continue to do, unless, as I confidently expect, the anti-trust laws and the Federal Trade Commission law are successfully invoked to frustrate Minerals Separation's intention and purpose and to invalidate this provision of its standard license agreements.

Both of the points above mentioned were comprehensively discussed in my paper before the Conference, which you printed in full on December 11, 1920. Knowing, however, how natural it is for your readers to attach to your editorials greater weight than they do to any contributed article, I hope that, to prevent perhaps disastrous misunderstanding on your readers' part, you will find space for this overlong letter.

GILBERT H. MONTAGUE.

New York, December 18, 1920.

Mining in Dutch Guiana

The Editor:

Sir—It is surprising—even in these days when gold has lost so much of its purchasing power—to see a region so rich in that metal as the three Guianas neglected. For there is a field close to the United States; quiet and

orderly politically; well connected with the rest of the world by steamships, cables, and wireless; healthy; of low altitude; producing within its own borders most if not all of the staple supplies required by the mining industry, and presenting by undeniable evidence mineral resources that have yielded richly in the past, and whose possibilities have yet scarcely been touched.

All this is particularly true of that part known popularly as Dutch Guiana and officially as the colony of Surinam. Here labor is cheap, docile, efficient, and obtainable under a contract system that eliminates all possibilities of strikes. In addition, the mining law is remarkably favorable for corporate operations on either a small or a large scale. Though within the tropics the country is healthy, and even salubrious for all who exercise reasonable temperance in eating and drinking, and wear clothing which experience has shown to be most suitable under the circumstances. Yellow fever and other tropical maladies are practically unknown. The death-rate—including natives—averages from year to year about 14 per 1000, a record equalled by comparatively few communities in any part of the world.

I have recently been studying the records of operations there by a well-known Western mining man of high standing and confess myself rather surprised at the results he has obtained. He has been operating on gold-bearing quartz during the last seven years. Beginning with a small outfit capable of crushing but 8 tons in 24 hours he has gradually enlarged this out of profits until at the present time his plant will treat 125 tons in the same time. During the interim he has crushed 60,000 tons, from which gold to the value of \$135,000 has been recovered and marketed, and by plate amalgamation only. His record on tailings indicates that his loss has been not less than \$1.50 per ton, of which at least 75% could have been saved by the installation of a cyanide system or concentrating machinery.

Now here is a demonstrated proposition that has been built up on its own profits, that is based upon an ore carrying \$3.37 in recoverable metal, and of which there are millions of tons in sight directly on the surface both on and off his claims, all available by the simplest methods of quarrying. No underground work, no water to fight. No hoisting. Yet Siberia seems to be more attractive. What is the reason? Is it political, or economical, or merely psychological?

THEO. F. VAN WAGENEN.

Denver, December 4.

Poor Zones and Enrichments

The Editor:

Sir—The re-opening of the Plymouth mine in Amador county, and the results, as recounted so concisely by W. J. Loring in your issue of November 27, should start others thinking. The policy of the Plymouth management, since the beginning of operations in 1911, has been an open and helpful one. The occurrence of poor zones along the Mother Lode in other counties of California has been frequent, resulting in many companies suspend-

ing operations in the past, while others have exercised better judgment and continued, benefiting thereby. The Plymouth found a poor zone for 600 ft. below the 2450 ft. level, followed by high-grade ore; the Empire had no ore between the 1300 and 2100 ft. levels; the North Star had about 600 ft. of barren vein below the 1200-ft. level; and the Central Eureka seemed to be exhausted at 3400 ft. during 1918, but sinking to 3700 ft. revealed another shoot, and now the company is disbursing regular dividends. Another splendid example is the Carson Hill, now the third largest gold-producer in California, and the result of Mr. Loring's experience. Considering past results and lacking their geologic deductions, we find praiseworthy work under way in re-opening the Allison Ranch, Idaho-Maryland, and Old Eureka mines, all old producers. The North Star is resuming work at its Massachusetts and New York claims, closed years ago presumably through the usual barren zone; also the old Murchie mine near Nevada City. Note how the Tonopah Belmont resuscitated the old Shawmut mine. Apart from abnormal conditions, what is the matter with the Bunker Hill, Fremont, Amador (Original Amador), South Eureka, Oneida, Gwin, Black Oak, Utica, and others? Cannot more capital be raised to go ahead with these mines? All are fully equipped. At Sierra City is another instance: the Sierra Buttes mine yielded gold worth \$17,000,000 to a British company between 1870 and 1905, but save for spasmodic exploration and milling little has been done since. Nearly all mining was done through nine tunnels. I was told recently that geologic conditions have not changed, and that a wide vein remains, although of low value. The veins are quartz fissures with a greenstone and serpentine foot-wall, and a quartz-porphphy hanging wall. It is a pity that a modern 40-stamp mill and cyanide plant, such as on the Sierra Buttes, is left to the mercy of the elements, snow having already eaved part of the roof. While on this topic, it is not out of place to draw attention to the bulletins recently published by the State Mining Bureau at San Francisco. I refer to 'Mines and Mineral Resources of Nevada, Plumas, and Sierra Counties', three separate volumes, compiled by Errol MacBoyle after a personal inspection of those regions. They are of great value. My work here has necessitated a close study of these bulletins, and I am surprised that so many apparently worthy mines are idle. There are also a number of drift-gravel properties that should demand attention. Exploration companies would do well to have copies of these reports on file. Perhaps they know all about the counties mentioned, yet something worth-while may have escaped their attention. It is to be hoped that when conditions improve, genuine investigation will be resumed in California. Mr. Loring has given a most practical hint; let others profit by it.

M. W. VON BERNEWITZ.

New York, December 10.

EMERY is mined at Naxos, in Greece, 9000 tons being the output in 1919.

Karl Eilers v. Guggenheims

Petition of Karl Eilers for a Writ of Mandamus Requiring the American Smelting & Refining Co. to Give Him Access to the Stock Register of the Company

SUPREME COURT, NEW YORK COUNTY

In the matter of the application of Karl Eilers for a writ of mandamus against American Smelting & Refining Company and David A. Crockett.

Sirs:

Please take notice that upon the annexed petition of Karl Eilers duly verified the 11th day of December, 1920, the undersigned will move this Court, at a Special Term Part I thereof, to be held at the County Court House in the Borough of Manhattan, The City of New York, on the 20th day of December, 1920 at 10.15 o'clock in the forenoon or as soon thereafter as Counsel can be heard, for a peremptory writ of mandamus under the rules of this Court, directed to the above named American Smelting & Refining Company and David A. Crockett, requiring the said American Smelting & Refining Company and David A. Crockett thereafter forthwith to permit the said Karl Eilers, his agents, accountants and servants, to inspect the stock book of the American Smelting & Refining Company and to make extracts therefrom, and for such other and further relief in the premises as may be just. Dated, New York December 11th, 1920.

WILLIAM U. GOODBODY,
Attorney for Petitioner.

To: American Smelting & Refining Company
David A. Crockett, Esq.,
William F. Schneider, Esq., Clerk of County of New York.

NEW YORK SUPREME COURT, NEW YORK COUNTY

In the matter of the application of Karl Eilers for a writ of mandamus against American Smelting & Refining Company and David A. Crockett.

To Special Term, Part I, of the Supreme Court of the State of New York for the County of New York:

The petition of Karl Eilers respectfully shows and alleges:

FIRST: That your petitioner resides at Sea Cliff, Long Island, New York.

SECOND: That American Smelting & Refining Company is a corporation organized and existing under and pursuant to the laws of the State of New Jersey. Said Company was incorporated on the 4th day of April, 1899. It has an authorized capital of \$115,000,000, represented by 500,000 shares of preferred stock and 650,000 shares of common stock. To the best of my knowledge and belief all of said preferred stock is issued and outstanding, and of said common stock, 609,980 shares are issued and outstanding.

THIRD: I have been since the incorporation of said

Company, and am now the owner of 210 shares of its preferred stock. I have been since 1916 and am now the owner of 17 shares of its common stock. I am also the owner of 200 shares of the preferred stock of said Company which I acquired from the Estate of Franz Fohr, who died July 27th, 1919, but which stock has not yet been transferred to my name by the Executor of such Estate.

As one of the three co-executors of the Estate of my father, Anton Eilers who was one of the founders of said Company, I am the holder and owner of 2170 shares of its preferred stock. In this stock I am beneficially interested.

Other members of my family whom I represent are holders and owners of preferred stock of said Company; their holdings aggregate 941 shares.

In my personal and representative capacities my total holdings are 3536 shares. For many years prior to the last annual meeting of the Company, which was held on the 7th day of April, 1920, I was a director and latterly Senior Vice-President of said Company.

FOURTH: The American Smelting & Refining Company is not a money or railroad corporation and has offices for the transaction of its business in this State and within the County of New York, to wit: at No. 120 Broadway, Manhattan, New York City, and another office for the transaction of such business, and particularly for the transfer of its securities, at No. 149 Broadway, Manhattan, New York City.

I am informed and believe that said corporation keeps at its said office at No. 149 Broadway, New York City, a book known as a stock book containing the names, alphabetically arranged, of all persons who are stockholders of the corporation, showing their places of residence, the number of shares of stock held by them respectively, the time when they respectively became owners thereof and the amount paid thereon, and that said stock book is in charge of one D. A. Crockett, who is known as the "Transfer Agent" of said Company.

FIFTH: That on the 11th day of December, 1920, during business hours, to wit, at 11:30 A.M., I went to the said office of the said Transfer Agent of the American Smelting & Refining Company at No. 149 Broadway, New York City, and being then a stockholder of record of such corporation for at least six months immediately preceding such time, made a demand upon the said corporation and upon the said D. A. Crockett for an inspection of said stock book and for the opportunity to make extracts therefrom.

I am informed and believe that in March, 1920, said stock book contained the names of about 19,000 persons

who were then stockholders of said corporation and I believe that the number of names has not materially diminished since that time.

At the time I made such demand said corporation and said D. A. Crockett, the Transfer Agent thereof, wrongfully and in violation of Section 33 of Chapter 61 of the Laws of 1909 (New York), known as "The Stock Corporation Law," refused to allow said stock book to be inspected by me or to allow me or my duly accredited agents and attorneys to make extracts therefrom.

SIXTH: The next regular annual meeting of said corporation will occur in the month of April, 1921.

The purpose for which I desire to inspect and make extracts from the stock book of said corporation is to enable me to communicate with other stockholders of said corporation in order to consult with them relative to effecting a change in the management of the affairs of said corporation by the election at said annual meeting of a new Board of Directors for said corporation. To that end it is necessary that I place myself in communication with stockholders whose holdings of stock are as large or nearly as large as my own, for the purpose of forming a Stockholders' Committee, and then to communicate with other stockholders to secure proxies, or the direct votes of stockholders, for the election of persons as directors of said corporation other than those now holding office as directors. I can accomplish this only if given free access to the stock book of said Company.

I am moved to do this because of an honest belief that a change in management is vitally necessary for the well-being of said corporation. I desire the interests of said corporation promoted that I and those whom I represent may as stockholders be thereby benefited. Also because of the association of my father with said Company from its inception to his death, and my own association with said Company as employee, director and officer for over thirty-one years I feel a keen personal interest in said Company, and its well-being and development.

SEVENTH: From 1907 to 1920 I was a director of said Company. From 1916 to 1920 I was Vice-President of said Company. As a director and particularly as an officer of said Company, I had opportunity to observe the methods of its management and I was finally convinced that said Company has been for several years, and is now under the control of persons who dominate its affairs and under whose direction the Company is managed, not for the benefit of its stockholders or for the well-being of said Company, but for the purpose of furthering the personal and selfish ends of said persons and in disregard of the interests of said Company. I am convinced that such domination of the Company's affairs has resulted in retarding its development; to my personal knowledge the Company has been thereby directly caused losses aggregating millions of dollars. I am convinced that a continuance of such domination will further retard its development and entail further large losses to the Company. I am convinced that only by a change in the Board of Directors of said Company, can such domination of its affairs be ended.

In evidence of all of which I make the following statement of facts and circumstances upon the information gained by me during my association with said corporation as a director and officer.

The said corporation was organized in 1899, a consolidation of various smelting interests being thus effected; the smelting concerns entering the corporation receiving cash or stock of the corporation in exchange for their assets. At that time the Messrs. Daniel, Murry, Isaac, Sol and Simon Guggenheim, owners of certain smelting concerns were invited to become stockholders in said corporation; to sell their smelting interests to the corporation in exchange for its stock. The said Messrs. Guggenheim refused such proposition.

In 1901 the said corporation had shown itself to be in every way successful, and thereupon the Messrs. Guggenheim proposed to place their smelting interests within the corporation in exchange for its corporate stock. They insisted that they be admitted to the corporation and their proposal being accepted, they thus secured approximately 300,000 shares of the corporate stock (\$30,000,000 par value).

The Messrs. Guggenheim at once demanded representation on the Company's Board of Directors, and were successful in placing upon said Board Mr. Daniel Guggenheim as Chairman and Messrs. Murry, Isaac and Sol Guggenheim as members.

In or about 1907 the holdings of stock of the Messrs. Guggenheim, except for a very small portion, were sold by them. As I am informed and believe such sale was forced upon the Messrs. Guggenheim by reason of business reverses. From that time the Messrs. Guggenheim apparently ceased to regard the interests of the corporation and sought to employ it solely to serve their own ends. In spite of the fact that they no longer held stock in the corporation to an amount which gave them any substantial interest in its affairs they continued their membership on its Board of Directors and insisted upon dominating that Board and the affairs of the corporation.

Early in 1919 the said Solomon R. Guggenheim resigned from the Board; the said Messrs. Isaac, Daniel and Murry Guggenheim remained upon the Board, and the said Simon Guggenheim became President of the Company. By that time the Messrs. Guggenheim had so perfected their domination of the Company that they did and could with confidence presume the acquiescence of a majority of the directors. When in January of that year they decided that Mr. Simon Guggenheim should become President of the Company and Mr. Daniel Guggenheim, the then President, announced this in a circular letter to the stockholders as "the expressed wish of the Board of Directors". The Board of Directors had not in fact been notified, much less consulted, in respect of the proposed change in the presidency of the Company; they had been given no opportunity to express any wish in the matter. The Board met the expressed wish of the Messrs. Guggenheim and elected Mr. Simon Guggenheim their President. The situation in the Company under Mr. Simon Guggenheim was well stated by one of my

fellow directors—"Simon snaps the whip and all the rest have to jump".

During all the time aforesaid, from 1907 to 1920 while I was a director and officer of said corporation I found it impossible for me, or any of my associates on the Board of Directors to secure the adoption of any plan for the operation of the Company against the opposition of the Messrs. Guggenheim. The majority of the members of the Board of Directors were controlled absolutely by the orders of the Messrs. Guggenheim and were in fact merely dummies representing the Guggenheim interests. This was true to such an extent that on one occasion when I protested to a member of the Board for his obedience to all mandates of Mr. Simon Guggenheim, he replied to me: "I don't like to do this, but what are you going to do when you are working for a man".

About 1910 the Board of Directors on the orders of the Messrs. Guggenheim and over the protest of myself and Mr. Morse, adopted a resolution that the salaries of officers, directors and employees should be fixed by a so-called Salary Committee, of which Mr. Murry Guggenheim was then made Chairman. At this time Mr. Daniel Guggenheim and Mr. Sol Guggenheim had been drawing salaries ranging from \$25,000 to \$50,000 per annum while they were devoting almost their entire time and attention to business matters not connected with the affairs of the Company. This was a cause of irritation among the other officers and directors. From that time the Board of Directors had no power to fix the salaries of the officers and directors of the Company, and the Board of Directors could obtain no information from the Messrs. Guggenheim or from those directors who acted in concert with them as to the amount paid to the officers and directors of the Company. I believe the real purpose of this arrangement to have been to enable the Messrs. Guggenheim to perfect and continue their influence over the directors; by means of this Salary Committee controlled by the Messrs. Guggenheim they could by increases and decreases in salary reward the obedient and punish the recalcitrant.

About 1910 Mr. Newhouse and Mr. Stewart reported an opportunity to enter the business of tin mining in Bolivia. The Company with the consent of the Messrs. Guggenheim, expended considerable money in a thorough investigation of this proposition. Upon the report of such investigation coming in, the Messrs. Guggenheim opposed any action relative to the proposition. Thereafter the sons of Messrs. Murry and Daniel Guggenheim representing Guggenheim Brothers, the Messrs. Guggenheim's co-partnership, were permitted to examine the report of the investigation on file with this Company, and thereupon Guggenheim Brothers sent representatives to Bolivia and have since engaged in large tin mining operations there. A demand by certain of the directors of the Company that it be allowed to share in such operations was refused by the Messrs. Guggenheim.

In 1919 Mr. Guess, managing director of mines for the Company, advised the Board of Directors that he had secured an opportunity to purchase a one-fourth interest

in the Premier Silver & Gold Mine in British Columbia at a price which would be most advantageous to the Company. A majority of the members of the Executive Committee of the Company to which the matter was referred were in favor of accepting this offer but Mr. Simon Guggenheim, a member of the Executive Committee, and Mr. Murry Guggenheim, a director, objected and opposed its acceptance. It later developed that the sons of Messrs. Murry and Daniel Guggenheim representing Guggenheim Brothers, desired to purchase one-half of such one-fourth interest. Upon an arrangement being effected which permitted Guggenheim Brothers to purchase one-half of said one-fourth interest, Messrs. Simon and Murry Guggenheim withdrew their objection to a purchase by the Company of the remaining half of such one-fourth interest.

The business of the Company is the purchase and smelting of ores of various kinds, and the sale of metals, copper, lead, silver, etc. thus produced. The prices paid by the Company for the various ores are based on the current New York quotations for the metals in such ores. The Company learned from bitter experience that if losses from fluctuations in the prices of metals were to be avoided, metals must be sold as fast as smelted and refined, and only to the quantity smelted and refined; no sales substantially in advance of production could be made. Prior to the domination of the Company by the Guggenheim interests this was the established policy of the Company.

In respect of sales of copper, this policy was abandoned so soon as the Messrs. Guggenheim secured predominating influence in the Company's affairs. In copper, under the direction of Mr. Murry Guggenheim, futures were dealt in by the Company; that is to say, the Company made sales for future delivery against ore to be purchased and copper to be produced therefrom. I believe the Messrs. Guggenheim were influenced to this change in policy in respect of copper sales by their interests in various copper companies. I know that through the Messrs. Guggenheim contracts were entered into making this Company selling agent for such copper companies. In 1915 I was informed by a Mr. Willard Morse, one of the Company's directors, that as the result of this method of selling for future delivery the Company was losing on copper at the rate of \$1,000,000 per year. A statement prepared by a Mr. F. W. Hills, the Comptroller of the Company, disclosed losses from this source for the seven years 1912-1919 to aggregate over \$5,000,000.

My fellow directors, Mr. Morse, Mr. Brush, Mr. Newhouse, as well as myself, protested against this policy, but Mr. Murry Guggenheim insisted upon it and its continuance. Mr. Murry Guggenheim attempted to justify these losses upon the ground that the Company, through sales for future delivery, was enabled to retain the business of selling for the group of copper companies with which it had entered into the aforesaid contracts to act as sales agent; that this Company could thereby retain 1% selling commission from such copper companies. Had this Company abandoned the policy of selling for future

deliveries it would have reduced its losses from fluctuations in the price of copper to a minimum and I am convinced it could have retained the agreements with the copper companies. As I am informed and believe the more important of these companies were controlled by the Messrs. Guggenheim through stock ownership; and the abandonment of the policy of selling for future deliveries would have prevented very large losses from fluctuations in the price of copper to those companies as well as to this Company. The copper companies to which I refer are the Utah, Nevada Consolidated, Kennecott, Braden, Chino and Ray.

In 1920 the Messrs. Guggenheim carried their policy of gambling in metals further. At this time the copper market showed a tendency toward a sharp decline in prices. Having made the mistake of selling for future delivery in a rising market, the Messrs. Guggenheim now withheld copper from sale in a falling market. In April, 1920, as the result of this policy, the Company had on hand approximately 160,000 tons of refined copper. In the meantime the price of copper had declined at least 5 cents per pound (\$100 per ton) with a consequent loss, traceable to the Guggenheim influence, of at least \$15,000,000 to the stockholders of the companies concerned, the copper companies and this Company.

In the Company's purchase and sales of silver and lead, Mr. Brush continued to follow the policy, previously followed in sales of copper, of selling currently instead of for future delivery. The fluctuation of prices in the lead market during the period 1914-1918 were similar in percentage to the fluctuation of prices in the copper market and the Company's tonnage in lead was greater by far than its own tonnage in copper. Under Mr. Brush's policy the Company made a profit on its transactions in silver, and the Company's losses from fluctuation in prices of lead were held down to the comparatively small sum of \$465,060.71 for the period 1904-1918. For the same period, under Mr. Murry Guggenheim's policy, the Company's losses in sales of copper, according to a statement by Mr. F. W. Hills, amounted to \$4,638,934.85. The Messrs. Guggenheim were not so largely interested in silver or lead producing companies as in copper companies.

Of the directors of the company, Messrs. Prosser, Newhouse, Stewart, Morse, McGowan and I were those who were outspoken in expressing their views relative to the business and policies of the company; Messrs. Prosser and Newhouse were more ready to yield to the opinions and directions of the Messrs. Guggenheim; Messrs. Stewart, Morse, McGowan and I were insistent in pressing our views irrespective of whether they were in accord with the opinions and decisions of the Messrs. Guggenheim.

The majority of the remaining directors of the Company were men dependent for their livelihood upon the salaries they received. These the Messrs. Guggenheim could control by fear of dismissal, and these directors did not venture actively to oppose the mandates of the Messrs. Guggenheim.

At the time when Mr. Simon Guggenheim was elected

President of the Company, Mr. Newhouse was made Chairman of the Board of Directors. It is significant that immediately after the annual meeting in April, 1920, when I was forced from the Board, to which I shall hereafter refer, Mr. Prosser was promoted to the position of Vice President and at the same time three new vice presidencies were created and three other directors were placed in those offices. The opposition of Messrs. Prosser and Newhouse was silenced by these promotions and the loyalty to the Messrs. Guggenheim of the three other directors secured by the same means.

Immediately after his election as President, Mr. Simon Guggenheim informed Messrs. Stewart and Morse that their services were no longer required, and demanded their resignations. Mr. Stewart ceased to be a director. I am informed that at this time Mr. Newhouse protested to Mr. Simon Guggenheim that he was going too far, and thereupon Mr. Morse was allowed to continue as a director of the company but in a position of no influence and at a greatly reduced salary. At this time Mr. McGowan declined to continue as a director of the company under Mr. Simon Guggenheim and resigned from the Board of Directors.

In March, 1920, a few days prior to the regular annual meeting of the stockholders of the Company, I received from Mr. Simon Guggenheim a letter informing me that because of the difference in our views relative to the management of the Company, I must sever my connection with the Company. In the next month (April) I failed of re-election as a director. I append as Exhibits A and B Mr. Simon Guggenheim's letter to me and my reply thereto.

With the ousting of Messrs. Stewart, McGowan and myself, and the shelving of Mr. Morse, directors who actively opposed the Messrs. Guggenheim, and the silencing by promotion to office of Messrs. Newhouse and Prosser, directors who had been rather active in their criticisms of the policies of the Messrs. Guggenheim, and with the loyalty of the three directors promoted to the office of Vice-President assured by such promotion, the Messrs. Guggenheim have disposed of any possible opposition on the part of the Board of Directors and have placed themselves in a position to control and manage the Company as they may see fit without fear of effective criticism by the Board. Re-election of the present Board will continue the Messrs. Guggenheim in such position of dominance; a position which in the past has resulted in the staggering losses to the Company to which I have made reference herein.

EIGHTH: I have stated that I am moved to the instant proceedings by the honest belief that it is necessary for the well-being of the Company that steps be taken to secure a change in the Company's management. I have herein set forth with some particularity matters concerning the present management as establishing ample grounds for such belief on my part and therewith the honesty of my motives. I am not acting as a disgruntled ex-director or officer seeking revenge for his removal or his own re-instatement. I am convinced and I submit I

have grounds for the conviction, that the interests of the stockholders demand that they be acquainted with the situation in their Company. Because of my long association with the Company and because of the number of shares owned and represented by me I consider that I am the logical person to move that the stockholders may be so informed and that I am in a manner morally obligated to do so. My own holdings in the Company, those owned and represented by me, also make it a matter of great importance, financially, to me that I secure a correction of the existing situation in the Company affairs. In this connection I invite attention to the statement of the number of shares of stock held by the directors of the Company in 1919 and 1920 as disclosed by my letter, Exhibit B, and by a statement hereto annexed, marked Exhibit C.

While a director and officer of the Company I did not take the action which I now propose for the reason that the dominance of the Guggenheim interests was a matter of development and reached its climax only just prior to my removal as a director and officer. Owing to the fact that I was absent from New York City engaged in business matters for the Company, I was not in a position to realize how successfully the Guggenheim interests were campaigning to secure control of the Company or to what extent such control had worked to the Company's injury. When I discovered the facts relative to these matters I hoped through my own influence and the influence of my fellow directors, Messrs. Prosser, Newhouse, Stewart, Morse and McGowan to secure a correction of the situation; I believed it better in the interests of the Company to attack this from the inside and it was only when I found myself and my fellow directors, who had actively attempted to assist me in opposing the Messrs. Guggenheim, eliminated from the directorate of the Company, that I realized the impossibility of successful opposition to the Messrs. Guggenheim unless by and through the assistance of the stockholders of the Company.

Wherefore your petitioner respectfully requests that a peremptory writ of mandamus issue directed to the defendants directing them to permit the petitioner and his agents, accountants and servants to inspect the stock book of the defendant American Smelting & Refining Company, and to make extracts therefrom.

Dated, New York, December 11th, 1920.

KARL EILERS,
Petitioner.

WILLIAM U. GOODBODY,
Attorney for Petitioner.

State of New York }
County of New York } ss.

Karl Eilers, being duly sworn, deposes and says: that he is the petitioner in the above entitled matter; that he has read and knows the contents of the foregoing petition, and that the same is true to his own knowledge except as to the matters therein stated to be alleged upon information and belief, and that as to those matters he believes it to be true.

KARL EILERS

Sworn to before me this
11th day of December, 1920.

EDWARD F. ROEHM

Notary Public, Bronx Co. No. 18
Bronx Co. Register's No. 2140
Certificate filed in N. Y. Co. No. 225
N. Y. Register's No. 1276

EXHIBIT A

AMERICAN SMELTING & REFINING Co.,
120 Broadway, New York,

March 31st, 1920

Mr. Karl Eilers,
Vice President,
American Smelting & Refining Company,
120 Broadway, New York, N. Y.

My dear Mr. Eilers:

Shortly after I became President of the American Smelting & Refining Company, it became evident that you were not in sympathy with my administration.

I had hoped that time would work a change in your attitude, and bring about a better accord between us, but a year has gone by with no prospect of such a result. Our views differ so fundamentally and on so many questions, that we cannot, with advantage to the Company or in justice to either of us, continue to be longer associated in the management.

I have reached this conclusion with the deepest regret, because of our long association. The decision was reached after careful consideration, and I regard the step as being absolutely necessary for the welfare of the Company.

This letter is written that you may have an opportunity of yourself taking the initiative and tendering your resignation before the coming annual election on April 7th, if you so desire.

With assurance of personal regard and good will,

Respectfully yours,
(signed) S. GUGGENHEIM

EXHIBIT B

120 Broadway, New York City,

Hon. Simon Guggenheim, April 3, 1920

President,
American Smelting & Refining Company.

Dear Sir:

I have your personal letter dated March 31st, which was delivered to me the next afternoon and which suggests that I should resign from the American Smelting & Refining Company for the sole reason that you and I are not in accord.

You are very right when you say that I have not been in sympathy with your administration. That is, perhaps, one of the strongest reasons why my continued connection with the company should be to its advantage. Since your brothers caused you to be made President, your views and mine as to the administration of the company have differed fundamentally, possibly because we represent different interests and may be working for different ends. My family and I are now among the largest stock-

holders and have held the stock from the company's beginning, and we have no interests of any kind adverse to the company. You and your family associates have disposed of practically all of the 300,000 shares which you had when you assumed control and now, unless as traders in and out of its stock, you have practically no stake whatever in the company and may not be free from adverse personal interests.

I find from the stock records that at the time of their last election our directors held stock in the company as follows:

	Preferred	Common
F. H. Brownell		5
E. Brush (and family)	205	10
Joe C. Brownell	300	170
W. M. Drury	100	120
Charles Earl		40
L. C. Eakin	10	
Karl Ekers (and family)	3375	502
L. Frederick		1
H. A. Gass	5	
D. Guggenheim		100
Isaac Guggenheim	1	
Murry Guggenheim	100	
S. Guggenheim	100	
F. W. Hills	132	10
William Loeb, Jr.		100
W. S. McCormick		1
W. E. Merriss		
Willard S. Morse	10	
E. L. Newhouse	700	
E. L. Newhouse (family)	340	
Walter T. Page	500	
H. A. Prosser	10	100
F. R. Raiff		
C. A. H. deSaullies	100	
E. B. Schley		100
John N. Steele		5
Roger W. Straus	1	
H. R. Wagner		
C. W. Whitley (family)	100	
E. R. Reets		12
Total stock held by directors	6089	1291
Total stock outstanding	500,000	650,000

Throughout your administration my views as to policy have systematically been overridden by you.

I disapprove of gambling in copper, as I have disapproved of the gambling in copper during the year 1912 to 1918, when it occasioned a loss to the company of five or more millions of dollars. I feel that that loss should be made good. I have disapproved of the payment to certain members of your family of sums aggregating at least \$500,000 each in salary and office facilities during the past ten years, without services rendered.

I have disapproved of the arbitrary manner in which you have failed to consult the directors of the company, men who, in many cases, have had far more experience than yourself, or, consulting them, have failed to give the slightest attention to their views.

From the time when your brothers treated the directors as puppets in order to bring about your election, you yourself seem to have regarded and treated them as puppets. One of our present directors summed up the matter correctly when he stated: "Simon snaps the whip and the rest all have to jump". Such a method of operation would be harmful under any circumstances, but when employed by one whose interest may not necessarily be that of the company, it becomes appallingly dangerous. Now I have not had to jump, and I do not propose to jump, and I will not resign.

I have disapproved of your vacillation, of your financial policy and your lack of any consistent operating and

extension policy, of your treatment of the company's valuable employees. I believe that you have been undermining the loyalty of the men and destroying the organization which should be the company's most valuable asset.

I have disapproved of the management being in the hands of those who have disposed of their stock interest and who have what should be competitive interests, of the failure in prosperous times to put aside proper funds for more difficult times, of the policy which has made it necessary to take up measures needful for the company through indirect and personal suggestions of a particular few, rather than through the company's regular organization.

I have viewed with alarm our unsatisfactory earnings and the decline of the market price of our stock during the period of your direction.

In requesting me to resign, it is evident that you, with at most a transitory interest in the company, have found my single minded zeal in the company's behalf inconvenient. If I could consult only my own personal convenience, I would be inclined to accede to your request. But I cannot forget that there are many matters that demand attention in the interest of the stockholders and that, as shown by the stock books at the time of the last election, I am one of the few directors who represent a substantial stock ownership and whose personal stake therein is so great as necessarily to make the company's prosperity their own first interest. Furthermore, as from length of service, I have become the company's senior Vice President and have devoted practically my entire life to its service and that of its predecessor, it is quite possible that I might be of more service and value to the stockholders than one otherwise similarly situated but without that training and experience.

I have desired, perhaps mistakenly, to preserve harmony in the company, in the hope that you might yield to advice or to evident result or lack of results, and soon might find other fields of activity more suitable for you, and the company thereby obtain the necessary change in management without the publicity and other disadvantages of a contest. As for those reasons I have up to this time made no effort to prevent it, it may be within your power for the time being to force my retirement from the Board. Nevertheless, I must most emphatically decline to resign, as I feel that it would be a betrayal of my duty to the stockholders voluntarily to abandon them, even for only a few days.

In so far as our views have not been in accord, as we both say that they have not been, the event seems to have proved that it would have been to the interest of the company and of all, perhaps, except yourself and yours, if my views and not yours had prevailed. It would seem obvious that under the circumstances the proper remedy would be your resignation and not mine. It is also obvious that the interests of the company and its stockholders require an immediate change in the management.

I therefore suggest that you should forthwith tender your resignation as President of the American Smelting

& Refining Company and should at once take steps to make up to the company, for the stockholders, the various losses which it wrongfully and unnecessarily suffered.

Yours Very Truly,
(signed) KARL EILERS

EXHIBIT C

Stock of the American Smelting & Refining Company Held by Members of the Board of Directors

	—April 1, 1919—		—April 1, 1920—	
	Preferred	Common	Preferred	Common
E. L. Newhouse	700	...	700	...
" " family	340	...	340	...
F. H. Brownell	...	5	...	5
" " Mrs.	...	...	100	...
E. Brush and family	205	10	...	...
J. Clendenin	390	179	390	179
W. M. Drury	100	120	100	200
Charles Earl	...	40	...	40
L. G. Eakins	10	...	10	...
Karl Eilers and family	3375	502	3575	47
L. Frederick	...	1	...	1
H. A. Guess	5	...	5	...
D. Guggenheim	...	100	...	100
Isaac Guggenheim	1	...	123	...
Murry Guggenheim	100	...	...	1500
Simon Guggenheim	500	...	100	...
F. W. Hills	132	16	132	16
William Loeb Jr.	...	100	...	10
W. S. McCormick	...	1	...	1
W. E. Merriss	...	...	...	8
W. S. Morse	10	...	10	...
Walter T. Page	500	...	600	...
H. A. Prosser	10	100	10	...
F. R. Raiff	...	...	...	5
E. R. Reets	...	...	...	12
C. A. H. deSaulles	100	...	100	...
E. B. Schley	...	100	...	100
John N. Steele	...	5	...	205
Roger W. Straus	1	...	1	...
" " Mrs.	...	...	74	...
H. R. Wagner	...	...	...	200
C. W. Whitley (Dorothy)	10	...	...	...
C. W. Whitley	...	...	10	...
Total held by directors	6489	1279	6380	2629
out of a total of	500,000 preferred			
	610,000 common			

Tin in Malaya

Fifteen years ago Malaya produced over 60% of the world's tin; today the figure stands at less than 40%. In 1903 Bolivia was credited with under 10,000 tons; today that country is the second largest tin-producing country of the world and unofficial estimates give it 20 to 25% of the total output. Nigeria, whose output ten years ago was practically negligible, is returned in official statistics as producing in 1917 nearly 10,000 tons. The Malayan production in 1919 is given as 36,867 tons, compared with 50,000 tons five years before. Yet here is a rather curious circumstance. Taking official statistics for the years 1903, 1904, and 1905, and those 12 years later it is noted that the total output of ore has on the whole increased. The loss on Negri Sembilan output is more than offset by the gain in Pahang, while the loss on Selangor is easily cared for by the gain in Perak. The deduction is that although the percentage comparison of Malayan output with the world's total has fallen owing to greater production elsewhere, the actual production has considerably increased. Although production has been affected by cumulative years of war restrictions and hindrances and present figures do not indicate the real strength of Malayan ore production, there is sufficient ground for urging that the industry should be taken more

carefully into consideration. At present there is one large and well-known American mining company operating in the Federated Malay States. This firm is importing large quantities of material and sending out capable men as prospectors. Realizing that they must do more than mere surface mining to obtain results in the future and perhaps stimulated by the advent of the American company, already referred to, many of the local mining corporations are taking a keener interest in scientific mining and are preparing to go ahead on a much more thorough principle.—Commerce Reports.

Standardizing in Mining

Standardizing mining operations presents problems quite different from the problems of the manufacturer. Methods of a successful factory may be duplicated by copying its arrangement and equipment and following its production details; standardization can readily be applied to most manufacturing processes, especially if the article manufactured is produced in large quantities. Mining operations, on the other hand, are carried on under conditions that vary widely in different mines and even in the same mine. No two mines are alike and methods that prove efficient and economical in one mine are inefficient and uneconomical in another, where the formation and ore occurrence are of a different type. Standards to be effective must be specially worked out to meet the conditions of the particular mine in which they are employed, says Robert Linton, president of the North Butte Mining Co., in 'Mining and Metallurgy'.

It should be emphasized at the outset that any studies of standardization and efficiency should primarily be directed to helping the underground workman do his work more skilfully with less effort and less fatigue. It is an axiom in every line of industry that the most skilful workman is, as a rule, the workman who does his work with the greatest ease. The purpose should be to devise means for further development of skill, to make it possible for more men to possess it, to eliminate all avoidable delays and lost motion in the working organization, and thus enable them to do the maximum amount of work without injurious overexertion. Given good working conditions and a square deal, the average workman would rather feel that his day's work turns out something of benefit to his employer than not, and is willing to do his best if he knows his efforts are recognized and compensated for on a fair basis.

The miner was formerly a member of a highly specialized trade—skilled in the manipulation of drills and the use of explosives, familiar with varying kinds of rock, trained to observe anything and everything that affected the particular mining job on which he was employed. There are still many such skilled miners working underground, and every mine superintendent is on the lookout for them, but there are also many who do not possess this skill and who work much harder without accomplishing as much because their efforts are not utilized to the best advantage. Standardization of methods benefits such men particularly.

The Future of Copper

By Edwin C. Holden

The rapid change in copper prices during the past few months has made producers and consumers alike eager to look into the future. Prophecy is an extra-hazardous occupation, but in the case of copper a review of its record during and prior to the War and a consideration of present industrial conditions make some general deductions possible. In any event, the valuer of copper mines must make the attempt if he is to reach any clear-cut conclusion.

The record of the copper industry in recent years is summarized in the accompanying table compiled principally from the 'U. S. Mineral Resources' and modified as to foreign production by 'The Mineral Industry'.

matte, blister, refined, manufactured, and scrap copper; the stock is of new refined copper and is not to be confused with that far more important figure, the copper surplus, which includes blister and copper in all unconsumed forms, whether in the hands of producers or consumers.

Data on the copper surplus are only approximately obtainable. The normal surplus for the United States has been stated as about 400,000,000 to 500,000,000 lb. In January 1919 it was variously estimated as between 1,000,000,000 and 1,800,000,000 lb., the increase being due to the agreed continuance of war production after the Armistice. It was reduced during the spring of that

Copper Statistics
In millions of pounds

Year	—Production—		—United States—		Excess export	Stock	Consumption	Price, cents per pound
	Foreign	U. S.	Imports	Exports				
1901	558	602	176	227	51	210	434	16.110
1902	559	660	162	376	214	163	493	11.636
1903	682	698	167	313	146	230	485	13.335
1904	712	813	182	556	374	208	461	12.823
1905	692	902	211	549	338	132	642	15.590
1906	659	918	226	468	242	139	669	19.278
1907	717	869	253	509	256	120	632	20.004
1908	723	943	219	662	443	122	498	13.208
1909	778	1093	322	683	361	141	712	12.982
1910	848	1080	344	708	364	123	736	12.738
1911	856	1097	335	786	451	89	678	12.376
1912	988	1243	410	775	365	105	862	16.341
1913	984	1224	410	926	516	90	723	15.269
1914	878	1150	306	840	534	174	532	13.602
1915	990	1388	316	681	365	82	1115	17.275
1916	1162	1928	462	790	328	128	1554	22.202
1917	1243	1886	556	1133	577	114	1323	27.180
1918	1137	1909	576	748	172	186	1671	24.628
1919	....	1311	411	517	106	631	754	18.691
1920*	....	1343	408	580	172	...	...	17.522
Hypothetical data based on projecting 1901-13 curves to 1920 and 1921								
1920	1180	1580	450	1100	650	...	900	.....
1921	1220	1630	460	1130	670	...	920	.....

*Estimated.

The curves based on these figures are given in Fig. 1. The average price of New York electrolytic copper for the pre-war years 1906-1913, inclusive, was 15.274c. Several of the large porphyry mines came into production during this period, otherwise the production and price curves would diverge and show that under pre-war cost-schedules the price of 15.274c. per pound was not sufficiently profitable to stimulate production. The sharp break in production when the price dropped below 14c. in the depression preceding and during the opening months of the War is another indication of this.

In the above table the domestic production is that from United States ores; the imports and exports include ores,

year and in November 1919 was reported as 1,000,000,000 and in January 1920 as 940,000,000 lb. During the first half of 1920 the stock of refined copper was reduced about 150,000,000 lb., but blister probably increased, leaving the surplus in the early summer at about 850,000,000 lb. Exports dropped off sharply during the summer, June actually showing an excess of imports, and the surplus had probably increased considerably up to the time of the break in price to 15c. in October.

The normal consumption of the United States before the War had risen to 65,000,000 lb. per month. It doubled during the War and the indications for 1920 are for about 95,000,000 lb. per month, or 20,000,000 lb. more

than normal expansion would require. This great domestic consumption goes far toward neutralizing the depressing effect of the abrupt shrinkage of the European market.

Copper's war record was unique. The world's production rate increased over 40%, whereas steel increased only about 10%, and coal, pig-iron, and lead never reached their pre-war maximum. See Fig. 2.

Projecting the average curves of the copper industry for the period 1901-1913, inclusive, through to date, they indicate that had there been no war and a constant rate of increase, the United States production for 1920 would have been 1,580,000,000 lb., or 230,000,000 more than the actual, the imports 450,000,000 lb., or 40,000,000 lb. above the actual, the domestic consumption 900,000,000 lb., and the exports would have risen to 1,100,000,000 lb., or 500,000,000 lb. above the actual and within 30,000,000 lb. of the record shipments of 1917.

The excess produced during the past six years over the normal increase was 1,290,000,000 lb. in the United States and about 150,000,000 lb. abroad, the total being equivalent to about one year's United States production.

The monthly statement for copper in the United States for 1920 so far as available is as follows:

Copper in the United States in 1920				Price per pound
	Production	Imports	Exports	
Jan. . .	121,903,744	33,224,237	49,680,000	18.918
Feb. . .	117,450,000	39,168,129	57,600,000	18.569
March. .	120,309,316	28,874,473	88,030,000	18.331
April . .	116,078,871	21,949,390	64,390,000	18.660
May . .	114,964,207	44,860,543	83,280,000	18.484
June . .	116,107,856	51,530,408	30,100,000	18.065
July . .	109,729,510	30,491,424	46,756,000	18.576
Aug. . .	116,430,654	31,360,881	45,865,000	18.346
Sept. . .	104,919,262	30,561,643	.....	18.144
Oct. . .	105,104,591	.....	.....	15.934
Nov. . .	105,000,000*	.....	.....	14.257
Dec. . .	95,000,000*	.....	.....	14.000*
	1,342,998,011*	408,000,000*	580,000,000*	17.522*

*Estimated.

The excess of exports over imports for 1920 is about 178,000,000 lb. For the past three years the total of 350,000,000 lb. shows a drop to one-third the pre-war rate, thus indicating sharply the retrenchment abroad due to unfavorable exchange, money stringency, and the existence of available munition-scrap copper.

Regarding the future of copper, prophecies covering temporary fluctuations are almost worthless, but a study of past performance and consideration of present economic tendencies make some general deductions possible.

It has become too trite to say that the present depression in copper, as in all other basic products, is healthy though disagreeable. Tonics are usually bitter. The reaction has already carried copper far below present costs of production and it is not impossible that we may see 13c. copper before the inevitable adjustment is accomplished.

We produce 60% of the world's copper and ourselves use 35%. The remaining 25% we must market abroad.

The productive capacity of American copper mines was increased 60% and of refineries 70% during the War, but they are this year producing 200,000,000 lb. less than the normal pre-war rate of growth would require. Since the abortive buying of copper by Japan in 1919, how-

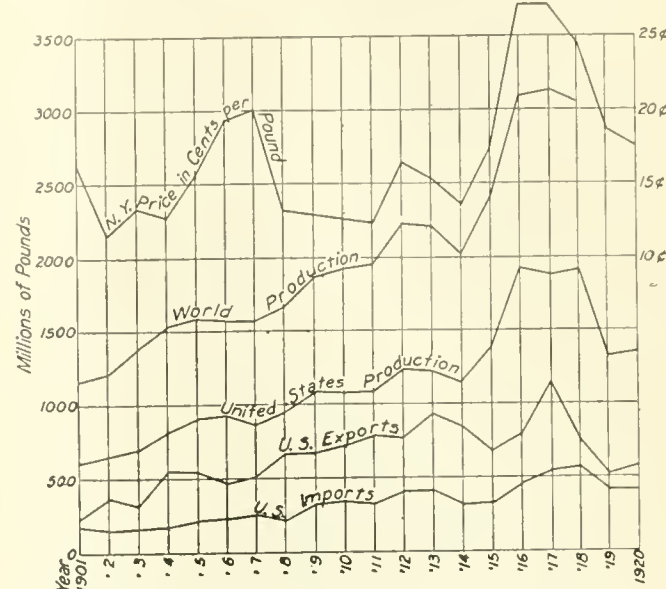


FIG. 1. THE COPPER INDUSTRY, 1901-1920

ever, the foreign demand has been light for reasons already given and because Germany, our largest customer, is still almost out of the market.

Until Europe can come back in the market on her pre-war scale, or our production shrinks to the consumption,

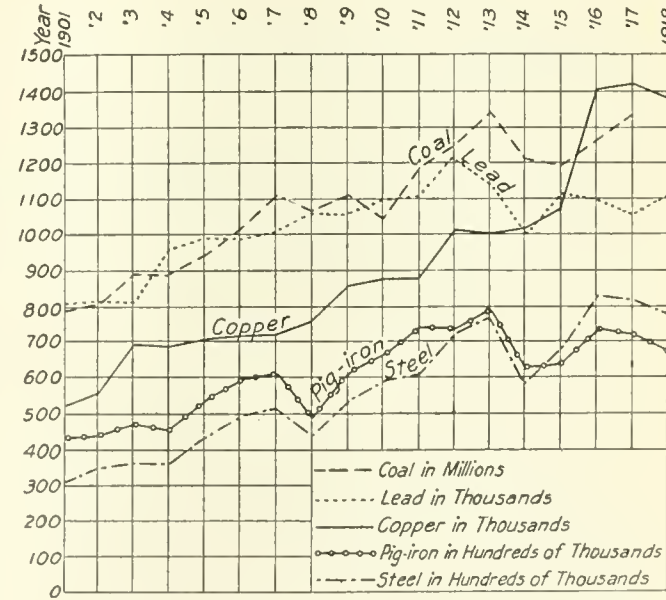


FIG. 2. WORLD'S PRODUCTION OF COAL, IRON, STEEL, COPPER, AND LEAD, IN METRIC TONS

the price of copper will be low. Europe will continue to get along on her stock of war scrap until she absolutely must buy or exchange is more favorable. It is conceivable that her scrap will last another six months and that, meanwhile, the copper market will continue in the doldrums. Domestic consumption has been excellent, how-

ever, and there are large prospective requirements. The low price is rapidly curtailing production, the full results of which will not be apparent in the market for several months.

What should be the future price of copper?

A recent tabulation* from the last annual reports of ten of the largest producers representative of all the important copper districts gives their average cost of production at 16½c. per pound. Six of the reported costs were exclusive of depreciation or of Federal tax or other head-office charge, so we can safely assume that these large producers required a selling price of not less than 17.5c. to make a profit, and the rapidly declining production indicates that the smaller producers were not prospering at the prevailing price of 18.69c. None of the important copper dividends declared in 1919 were fully earned.†

Under the conditions prevailing in 1920, it is probable that a price of 20c. would have maintained normal production. Relative costs and returns must ultimately keep step. Deflation is now taking place and the reaction so long delayed will probably have momentum enough to pass the neutral point. The world has not only its regular industrial growth to care for, but unprecedented war-bills to pay, and it will be so difficult to do this on the basis of the pre-war value of money that a 10% advance on the old standards of value seems a moderate depreciation to expect for the world's currency. If this were the only consideration affecting copper, a simple addition of 10% to the pre-war curve of copper prices would tell the story of probable prices; but this is not the only factor.

The copper market was unique during the War, and its future is also unique. The world's copper surplus cannot, with most liberal allowance for war salvage, fill a single year's requirements. A long-postponed era of electrification is due and the productive capacity of the industry, as a result of the War, is already provided. The United States will continue for a long time to be the world's copper store-house, but already depletion is keeping close pace with development, and when the home market absorbs our entire production, the domestic industry will be protected by the freights from South America, Asia, and Africa. This, however, is in the distant future.

A 10% advance on the average price from 1906 to 1913 of 15.274c. makes 16.8c. as a probable average price, with production, export, and consumption as given in the hypothetical figures for 1921. Costs will not apparently average so low in 1921 as 10% over 1913, but it is also certain that exports will not approach the theoretical quantity.

Judging by the analogy of pre-war experience, then, the price of copper for the next decade should fluctuate between 14 and 22.5c., depending upon market conditions; but the average price on which a mine-valuation or other long-time operation should be based may be taken at 17c. The financial optimist who believes in the return

of the old-time dollar, and the industrial pessimist who does not believe in the continued expansion of copper consumption will join hands and continue to figure on 15c. copper.

A Zinc Mine in New York State

The Northern Ore Co., operating the Brown mine, near Edwards, St. Lawrence county, New York, treated 51,411 tons of zinc-bearing ore, which yielded about 10,240,000 lb. of zinc during 1919.

The 400-ft. inclined shaft has been abandoned, and only a vertical shaft 900 ft. deep and an 800-ft. inclined shaft are now operated. Considerable prospecting was done with a diamond-core drill on the large tract of land owned by the company, and the drill was also used in workings to find ore and reduce the amount of drifts run. Ore now being extracted from levels at 840 to 860 ft. is dropped to the 900-ft. level, hoisted, and trammed by means of a gasoline motor to the mill. The mill, which is constructed of steel and tile, is equipped with crusher, rolls, Dorr thickener, and 17 concentrating tables. The ore had been treated by flotation prior to 1919, but that process is not now in use. No jigs are used and the concentrate recovered is exclusively a table product, though experiments that are being made will probably result in an increased quantity of ore being treated and in the installation of jigs to treat middling. The table concentrate, which assays about 32 to 33% of zinc, is treated by 13 Electric Ore Separating Co. machines, which, by removing much of the pyrite, raise the zinc content to 49 to 53%. These electric machines treat wet concentrate, and to avoid the clogging of the riffles in the separator and ensure their proper operation it is necessary to remove by means of a powerful magnet all the small particles of metallic iron abraded from the rolls and crusher.

The average zinc assay of the crude ore treated ranges from 15 to 20%, and the finished concentrate, which is practically free from lead, usually averages about 49%. The pyrite concentrate, which contains about 43% of sulphur, is in good demand when cars are available for its shipment. The developed bodies of ore are large, and it is probable that others will be found on the large tract owned by the Northern Ore Company.

ALMOST every known gem is mined in Australia, but New South Wales leads all other States in the variety and value of precious stones produced. The black opal is said to be Australia's most beautiful gem, and it is claimed that Lightning Ridge, New South Wales, is the only part of the world known to produce it. The black opal has increased in value 300% in the last two years, the best quality bringing from £6 to £8 per carat. The stone ranges in size from 1 to 100 carats. Other stones of commercial importance found in Australia are the pearl, sapphire, diamond, emerald, ruby, topaz, and the turquoise. Of less value but of great beauty and brilliance are the peridot, zircon, tourmaline, and the aquamarine, which are found in New South Wales.

*E. & M. J'. Vol. 110, p. 889.

†Same. Vol. 109, p. 1147.

Sundry Details of Sampling at the Garfield Smelter

By Arthur B. Parsons

An accurate determination of the exact amount of metal and other constituents in each lot of ore received at a custom smelter is necessary for two reasons: first, it is the basis of settlement between the smelting company and the shipper of the ore; second, upon the exact knowledge of what is in the ores received depends the intelligent operation of the furnaces. Both these factors are recognized by the American Smelting & Refining Co. as being vital to the success of its smelting enterprises; the company wishes to pay for all the metal in the ore, but it does not want to pay for anything that is not there, and inefficient methods are as liable to be in error on one side as on the other. The first and most difficult step in a determination of the true contents of a shipment of ore is the sampling; this is one of the most carefully organized and thoroughly equipped departments at the Garfield smelter of the American Smelting & Refining Co. In January 1919 there was completed the construction of a new building in which is done the cutting-down of samples of crude ore coming from the sampling-mill together with the final preparation for the assay-office of all samples including ores, concentrates, by-products, and other material to be treated in the smelter. This building was designed after a careful study of the re-

quirements, and included in its equipment are a number of devices that make it of particular interest.

Another notable feature is the Martin unloading and sampling machine recently developed expressly for handling the concentrates, both from tables and from flotation-cells, shipped from the neighboring concentrators of the Utah Copper Co. Since this part of the process precedes the reduction of the samples in the 'bucking plant', as it is called, the Martin machine will be described first.*

The old scheme for sampling shipments of concentrate was the simple, almost primitive, but reliable method of unloading the cars by shoveling onto a belt-conveyor, each fifteenth or twentieth shovelful being set aside on a conveniently placed platform, where it was later half-shoveled once, twice, or even more times, depending upon the number of carloads in the lot.

The belt-conveyors and platforms were placed advantageously so as to expedite the work. The sample so obtained could be depended upon, and, although the amount of manual labor required was considerable, it

*The machine has been patented and the patent has been assigned by Mr. Martin to the American Smelting & Refining Company.

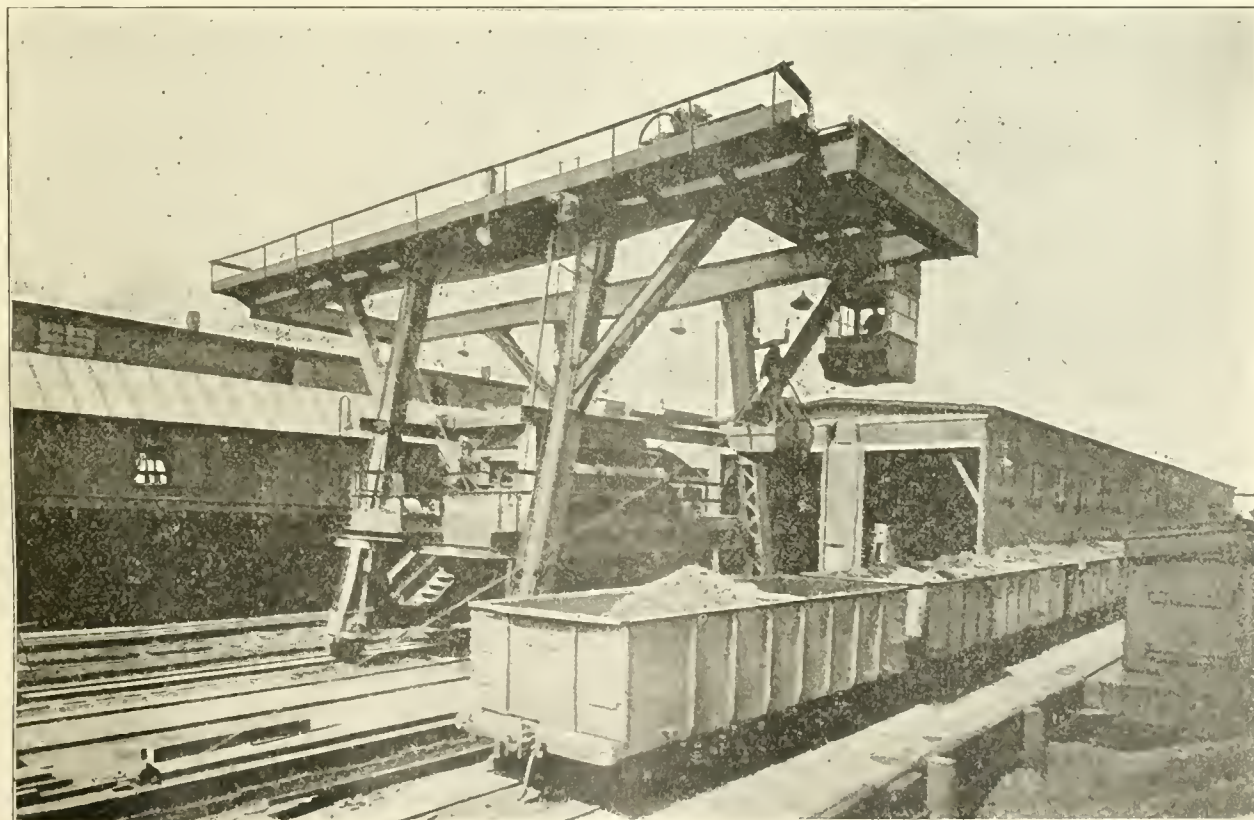


FIG. 1. MARTIN MACHINE FOR UNLOADING AND SAMPLING CONCENTRATE

was not deemed excessive. However, when flotation began to supplant the older methods of concentration a new problem appeared. Instead of the comparatively dry granular concentrates from tables and vanners, a material that was ideal for shoveling, there appeared a product more nearly like soft putty than any other familiar substance. When the Arthur mill was completely equipped with flotation machines and operations were at the maximum, 12 to 15 cars of flotation concentrate were received daily at the smelter. It was hard to get men to work at all and it was still harder to get them to shovel this putty-like concentrate. It had to be chopped to get it on a shovel; and by no means the least difficult operation was to cause it to let go of the shovel when it was once on. The work at one time[†] was done under contract by Greek and Italian laborers, the prevailing price before the War being 6 to 8 cents per ton, depending upon the moisture content and upon the amount of table-concentrate mixed with the flotation product. It may be noted that at the present time only enough straight table-concentrate is reserved at the plants of the Utah Copper Co. to supply the needs of the sulphuric-acid plant at the smelter. This plant is operated under a joint agreement between the mining and smelting companies, so that it is mutually advantageous to make the separate shipment; although, except for the acid plant, it would be better to mix all the table-concentrate with that from the flotation cells prior to the filtering process. This procedure gives a more porous cake on the vacuum-filters and consequently a drier one. Reverting to the coast of unloading by hand, it may be said that during 1917 and 1918 the contract price increased to such an extent that 20 cents per ton was paid on some lots. Even then strikes caused continual trouble, and congestion of cars in the yards was frequent. Moreover, mixing and half-shoveling were difficult and a great deal of work was needed to get a satisfactory sample.

Accordingly F. M. Martin, chief engineer for the company, with the assistance of his staff, undertook to devise a mechanical process for unloading and sampling the flotation concentrate. Their efforts were successful. After the usual experimenting, altering, and adjusting, a suitable machine was developed. It makes a sample in which both vendor and vendee have entire confidence; it chops up the concentrate and puts it in better condition to be conveyed to the bedding-bins; it is much quicker, and it is more economical.

Inasmuch as the general scheme, besides many of the details, was worked out by Mr. Martin, the machine has been given his name. The first unit, a photograph of which is shown in Fig. 1, was put in operation in the spring of 1919. The illustration shows the mechanism before the housing was built about it. This housing, made of wood, protects the sampling-machinery from rain and snow, and is heated for the convenience of the operator during winter. A second machine has recently

been completed, the only difference being certain changes in the steel frame. A drawing giving the general arrangement is shown in Fig. 2.

The method of operation is as follows: The concentrate is brought in flat-bottomed steel railroad-cars, holding 75 tons, to tracks on either side of the platform on which the unloader operates. The entire machine is mounted on a traveling gantry, which is moved by an electric motor as the car is unloaded; in fact, the gantry-track is so long that a train of five cars can be unloaded without the need for any switching. The actual unloading is done by a 14-yd. Williams clam-shell bucket so arranged that it can operate in cars on either side of the gantry-track, its load in either event being discharged in a central hopper at the top of the machine. The bucket has square-nosed shells and empties the car almost completely without assistance from hand-shovelers. The receiving hopper has a capacity of about 20 tons; in order to prevent packing too tightly, the force of the fall of the material from the clam-shell is broken by steel I-beams, spaced 3 ft. and resting over the top of the hopper.

The bottom of the hopper, 9 ft. square, consists of a rubber belt supported by, and traveling slowly with, an endless conveyor composed of wooden slats, 2 by 4 in., reinforced on the under side by 4-in. steel channels, these slats being carried on roller-chains. The speed of advance of the belt is variable, depending on the character and condition of the concentrate. It forces a continuous layer of concentrate through a horizontal space about six inches high across the 9-ft. width of the hopper just above the surface of the belt. A belt 9 ft. wide is unusual; the belts so far used were made specially by the B. F. Goodrich company by being placed crosswise in the press. They are six-ply and have a $\frac{1}{2}$ -in. pure rubber surface. It was planned at first to have them endless, but as this would necessitate tearing the machine to pieces when replacement was required, the ends of the belt were joined by a square-lapped splice made with copper rivets. The only visible wear after operation for a year is some snagging resulting from scraps of steel or iron that accidentally got into the concentrate.

The essential part of the scheme comes next. It is a 'chopping' device that meets the advancing layer of concentrate as it comes off the belt and cuts it into wide ribbons about $\frac{1}{4}$ in. thick. The arrangement consists of a central shaft at right-angles to the 'flow' of the concentrate on which are mounted 11 equally spaced discs, 15 in. diam., dividing the shaft into ten 12-in. sections. Threaded through $\frac{1}{4}$ -in. holes in each of these discs, near the circumference are 12 wires that are fastened on one of the end discs and are tightened and kept taut by small ratchets on the outside of the disc at the opposite end. As the cylinder revolves, the wires, of No. 12 spring steel, do most of the cutting, although the discs obviously cut the ribbons into sections. Smaller wire was tried at first, but the continual abrasion wore it out in a few days. No. 12 does better work than larger wire, and lasts from three to six weeks, depending on conditions.

[†]As described by T. A. Rickard in the 'M. & S. P.' of December 28, 1918. 'The Utah Copper Enterprise, No. IX. The Smelting of the Concentrate'.

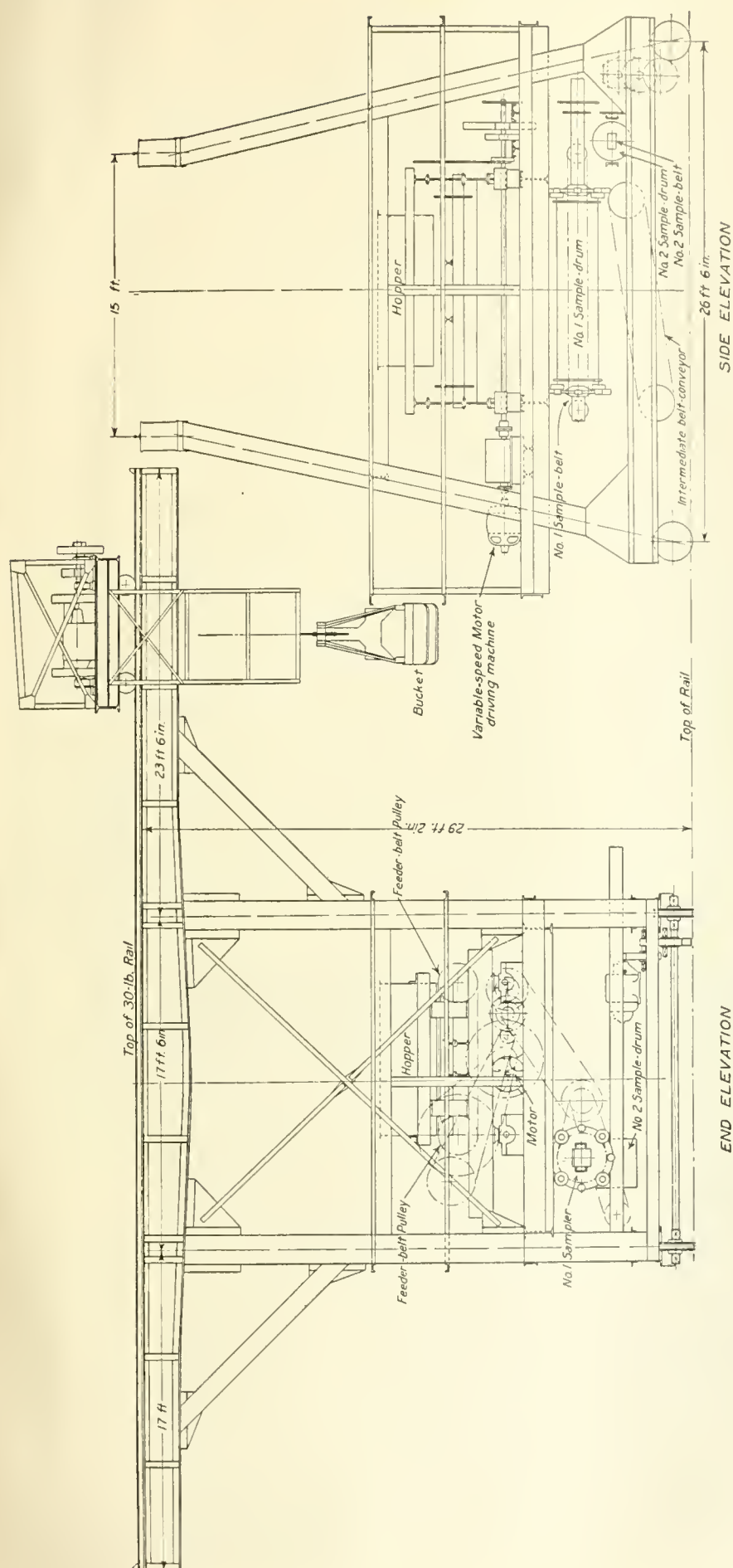


FIG. 2. GENERAL DRAWING OF MARTIN MACHINE

Revolving below the falling stream of 'chopped' concentrate with its axis parallel to the disc-shaft is a hollow cylindrical iron drum 30 in. diam. along the entire length of which is a 16-in. opening; that is, a portion of the circumferential surface is cut away. As this drum revolves, a fractional part, a tenth, of the concentrate falls through the opening onto a small 12-in. belt-conveyor traveling in the direction of the axis of the drum, while the remainder falls to the principal 24-in. belt-conveyor, by which the reject, after a series of transfers, is delivered to the bedding-bins. A precaution that has assisted smooth operation is the sanding of the belt-conveyor before the concentrate reaches it. A small portion of a peculiar lime-sand obtained from a deposit near Great Salt Lake is required for fluxing. Accordingly, the storage-bin for this sand is so placed that a quantity flows onto the belt before it passes under the Martin machine. The sticky concentrate falls upon the sand and the difficulty of removing it is lessened. The same belt system was utilized for unloading by hand before the Martin machine was built. To prevent concentrate sticking to the drum, a simple wire scraper is placed near the bottom just over the belt-conveyor. All parts of the machine are designed on the principle that the concentrate must drop vertically onto a moving belt; no matter how steep the incline, a chute will not do, because of the unavoidable accumulation of the extremely sticky material.

The small belt-conveyor within the drum carries a one-tenth cut of the entire bulk of concentrate. At its discharge end is a smaller and simpler wire chopper and a similar drum, which takes a further cut of one in fifteen, this sample being carried on a 10-in. belt-conveyor to an ordinary one-ton mine-car. The car is attached to the housing of the machine and travels in company with it during the unloading of a railroad-car. A new sample-car is used for each 75-ton car of concentrate unloaded. The ma-

chine is operated by direct current motors at 250 volts. When the Garfield Smelter was built, direct current was used exclusively and with a few exceptions it is used today. A 25-hp. motor controls the travel of the gantry, a series wound 5-hp. motor propels the carriage for moving the bucket crosswise. These are all operated from the crane man's cab. The sampling machinery is all run through gear and sprocket chain connections by a variable speed, 600 to 1800 r.p.m., shunt wound motor. With flotation concentrate a slower speed is required. To protect the mechanism against breakage in the event of excessive feed, a shearing-pin disc is inserted in the transmission system.

In addition to the flotation product, the Martin machine is used to unload and sample the table-concentrate, which is received in lots of four or five cars, at intervals of two or three days, to supply the acid-plant, as previously mentioned. This material is handled much more rapidly, though quite satisfactorily, and the expense of building a machine would be warranted even if there were no flotation concentrate to treat. Small lots of concentrate from miscellaneous sources are still sampled by the old method, that is, by reserving the fifteenth or twentieth shovelful and subsequently half-shoveling; the point is that the Martin machine is peculiarly adapted for large lots of concentrate of comparatively uniform grade, where no cleaning of the equipment is required when changing from one shipment to the next. The moisture in the flotation concentrate varies between 15 and 25%, the rate of operation of the machine varying with the comparative dryness.

Utah Copper concentrate is being unloaded at the rate of one car, or 75 tons, per hour at a cost of approximately 10c. per ton, including labor, power, supplies, repairs, and depreciation.

The car-samples, weighing approximately half a ton, are cut down to lot-samples of 75 to 100 lb. in a separate room. There are 38 covered bins along two sides of this room, each of which has a capacity of five or six tons of concentrate; these bins are just below the level of the track on which the one-ton sample-cars run, and they open on a lower working-floor entirely covered with $\frac{1}{4}$ -in. steel sheets. The samples from all the cars, from three to six, in a given lot are first shoveled by hand out of the bin; the pile is then moved by half-shoveling, the rejected portion going into wheelbarrows and thence to a small hopper feeding a belt-conveyor which joins that going to the bedding-bins. The sample is then coned and quartered by hand in the usual way by means of a sheet-steel cross until the resultant sample weighs about 100 lb.; it is then put in a covered galvanized-iron can and taken to the bucking-room for treatment, as will be detailed later.

The sampling-mill is a well organized department where the usual precautions are taken in crushing and cutting a sample of from 800 to 2000 lb. of crude ore reduced to quarter-inch. There is nothing particularly novel in the procedure, however, up to the point where this large sample is delivered to the newly built bucking-

plant. This building has a floor space of 100 by 64 ft. and is built throughout of reinforced concrete, with an exceptionally large window-area, the walls being almost entirely of glass. On the ground floor are the crusher, rolls, the equipment for mixing and cutting, and storage space for the rejects; on the upper floor are the drying-cabinets, pulverizers, and bucking boards, the last, as a matter of fact, being used very little, although the whole is known as the bucking department. There are also convenient glass-enclosed rooms for the use of the representatives of the ore-sellers when observing the sampling process.

Samples from the sampling-mill are received in cars on the upper bench, where, after being dampened, if necessary, they are fed by gravity into either of two 12 by 24-in. rolls made by the Mine & Power Machinery Co., the crushed material falling into a specially designed hopper-bottomed sample-buggy. This buggy is made of sheet-iron, is 33 in. square and 35 in. high over all, as shown in the accompanying sketch, Fig. 3. On each side at the top is a hook by means of which the car can be conveniently and quickly engaged by a sling hanging from a one-ton suspended Detroit electric crane, which runs to any part of the room on a series of overhead tracks and turntables. The buggy can likewise be moved about on the floor on four small wheels, two of which are swiveled. The hopper-bottom of the first buggy was made like an inverted pyramid, but it was found that an inverted gable was better for the purpose, and the present buggies or cars are shaped that way. A small are-gate fitted along the entire vertex of this V-shaped bottom permits the contents of the suspended car to be emptied in a small uniform stream. There are five such buggies in the equipment. The buggy containing a crushed sample is lifted by the crane and carried to a point above a second buggy, fitted with a specially-made 6-mesh screen, fashioned like a shallow funnel. The are-gate is opened and the ore runs in a sheet-like stream. By whirling the suspended buggy the ore is scattered over the screen and a little manipulation helps the under-size through. The oversize is poured into a wheelbarrow and fed to a Rodgers bell-grinder. This discharges directly into the second buggy, which has been rolled a short distance to be under the spout.

The next step is to mix the sample. Here again two buggies with a large funnel are used, three transfers being usually sufficient to thoroughly mix the 6-mesh material. The operation is thorough, rapid, and economical. After the third mix a one-inch split riffle is attached to the bottom of the suspended buggy by suitable hooks, so that when the gate is next opened only half of the ore goes into the buggy beneath, the remainder being diverted into an iron reject-can. This is repeated until a sample of 75 or 80 lb. is obtained ready for further reduction in the bucking-room upstairs. The exact procedure will depend on the approximate grade of the material being sampled but the variation will be unimportant. The resulting sample is an improvement over that obtained by the former methods of coning and quarter-

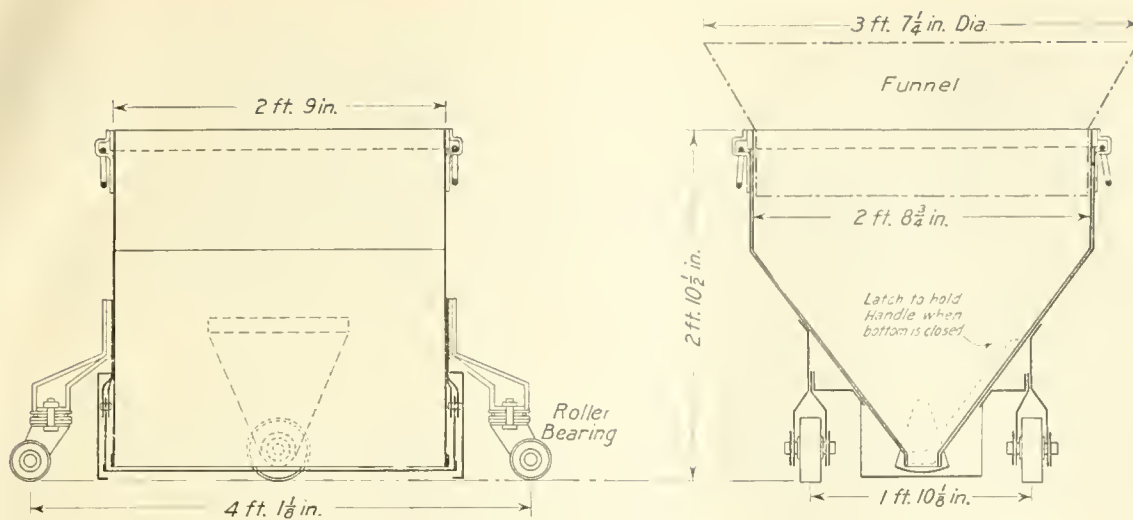


FIG. 3. DETAILS OF SAMPLING-BUGGY

ing by hand; being largely mechanical, it avoids many of the vagaries that may result from the personal equation, and at the same time is in accord with the principles on which fair sampling is based; moreover, it is rapid and economical, particularly in respect to the labor required.

An interesting point is the care taken of the rejects pending the final settlement. Instead of the customary wooden box, a clean tightly-covered sheet-iron can is used; there are 100 of these, 36 in. high and 30 in. diam., each mounted on a low wooden stand made of 2-in. plank, and with a clearance between the supports of approximately 4 in. from the floor. The purpose of this stand is to permit the use of a 1 1/2-ton Stn Bing lift-truck, an ingenious contrivance borrowed from other industries, but well adapted for the work of moving the heavy reject-cans. The operator runs the truck under the stand

and by means of a foot-lever lifts the whole load about an inch off the floor. After moving it to the desired point, the same simple mechanism lowers the stand and can to the floor. Another contrivance is a home-made dumper for reject-cans when they are released by the final settlement on the samples that they contain. It consists of a wood and strip-iron frame into which the can fits, and which is hinged to the edge of a small hopper that feeds a bucket-elevator. This elevator, just outside the building, delivers the reject directly into a railroad-car. The Detroit crane is used to dump the cans into the hopper after they have been suitably harnessed to the frame.

The bucking-room upstairs is divided by means of glass partitions into four sections, each for a definite class of samples. Each has practically the same equipment, the following segregation of the work being made: (1) regu-

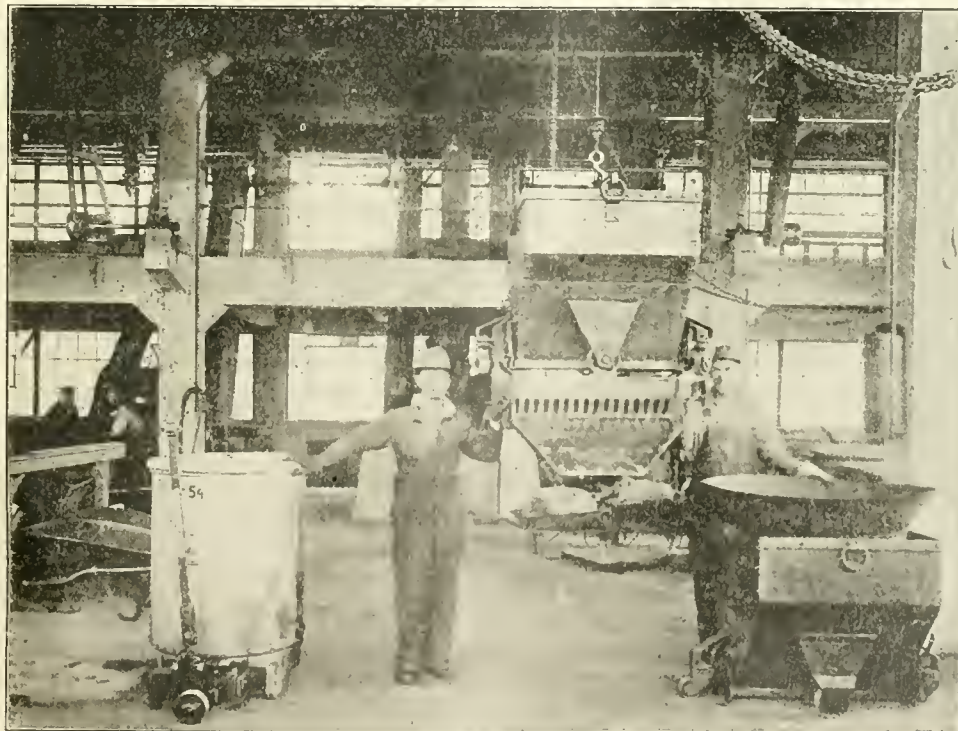


FIG. 4. SAMPLING-ROOM AT GARFIELD SMELTER

lar miscellaneous ores; (2) ores rich in silver; (3) ores rich in copper, matte, and other by-products; and (4) Utah Copper Co.'s concentrates. The manipulation of a sample of regular ore will be described. The 75-lb. sample is put through a 12-mesh screen, the oversize being crushed in a Rodgers bell-grinder until the entire sample has passed the screen. This crusher can successfully grind material that is somewhat damp. Instead of a cloth, a 16-in. cubical box of galvanized iron with a small door or gate at one corner is used as a mixer. This cube is placed in a lathe-like machine that revolves it at about 20 r.p.m., two opposite corners forming the axis of revolution. After mixing for from two to five minutes the sample is cut to a bulk of approximately 60 oz. by means of a $\frac{1}{2}$ -in. Jones rifle, and is then dried. Each section is equipped with a drying-cabinet composed of a series of shelves made of steam-pipes, and fitted with 12 separate doors. A Bristol recording thermometer is attached to each drier, the line of standard temperature, 230°F ., being closely followed at all times. The dried sample is then ground in a McCool pulverizer, a disc machine with an eccentric motion; any oversize on a 120-mesh screen is either run through the pulverizer a second time or is ground by hand on an ordinary bucking-board. The final mixing is done in a small 8-in. revolving cube similar to the one previously mentioned. When revolved at slow speed this mixer does remarkably good work, one point in its favor being the absence of a tendency to classification, which is frequently found when mixing is done improperly on a cloth. An advantage is that the mixing is uniformly good, providing the cube is kept revolving for the specified time; the result is not affected by carelessness or inexperience on the part of the man doing the work. After mixing, the sample is divided into the required number of portions for analysis by the vendor of the ore and by the smelting company, for unimpres, and for extras.

I am indebted to A. H. Richards, general superintendent of the Garfield smelter, for his kindness in authorizing the publication of these notes, and to N. L. Stewart, chief engineer at the plant, for courteous assistance in supplying me with detailed information.

The Broken Hill Strike

The Broken Hill strike, said to be the longest in history, has at length come to an end. When the last mail left New South Wales, about the middle of November, work had been resumed at one mine, but it was expected to be several weeks before operations could be got into full swing at all of the mines. Since the special tribunal appointed to settle the dispute gave its decision a couple of months ago, several conferences and controversies have taken place between the men and the companies as to just what the decision meant and on other matters, but an understanding, at least for the time being, had been arrived at, and the mines were ready for active work as soon as circumstances permitted. There are questions still outstanding, but both sides have been

so 'filled up' with this strike, which has lasted between 17 and 18 months and is estimated to have cost the nation about £12,000,000, that there is not expected to be any more striking for a long time. Another thing that makes this less likely is that the stringency of the money market throughout Australia is beginning to cause unemployment, and the time is believed to be approaching when all workmen will think more seriously than they have done in the past before throwing up regular and well-paid occupation.

Will This Work?

The question as to what shall be done with our dumps has long been a subject of discussion in mining and other circles, says 'The South African M. & E. J.' The low gold content of the residues, especially of recent years, due to improved metallurgical processes, has made the question of re-treatment of the dumps a remote possibility only. In any case the re-treatment of sorted residues containing one pennyweight or less has not hitherto been attempted on the Rand. A brief description of a novel plan is here given in order that our readers may understand the nature of the process and be enabled to form their own opinions as to its value. Seemingly it is based on Rittinger's law of concentration of particles of differing specific gravity in water. The sand is acted upon by water under a pressure of 35 lb. per square inch, and is thereby thrown into the atmosphere; in its descent the particles of different low gravity become separated and fall in layers. The heavier concentrate, which contains most of the gold, is collected and passed over Wilfley tables for final concentration, after which the recovered concentrate will be ground fine in tube-mills, or treated direct with cyanide to extract the gold; the other portion of the concentrate will be roasted for the ultimate recovery and the manufacture of sulphuric acid. A unit of three machines will treat about 1200 tons of sand per day, the concentrate from which will give from 12 to 25 tons per day for Wilfley-table treatment. Should the sand be refractory, roasting of the concentrate may be done, or fine grinding, which will have nearly the same effect so far as regards the extraction of the gold. The residue remaining after the treatment for the recovery of the gold will be further treated for the extraction of sulphuric acid, and with the very large tonnage to be treated daily this will form a considerable source of revenue, as the acid is in demand for many purposes on the Rand and elsewhere, as, for instance, in reduction works and in explosive-factories. The sand, it is claimed, will, by the process, be completely purged of its cyanide, and will then be amenable to treatment for the manufacture of bricks, concrete, etc., thereby affording a third useful industry. The pyrite residue can also be sold at a profit. Of the claims advanced we shall soon have demonstrable proof, since a new company is about to start treating at least one large dump near Johannesburg, and has on hand contracts for the treatment of millions of tons of residue.



FROM OUR OWN CORRESPONDENTS IN THE FIELD

ARIZONA

RICH ORE FOUND AT OATMAN.

CLIFTON.—Final payment to the Stargo Silver Belt Mining Co. on 26 claims was made on December 16 by the Stargo Mines, Inc. It is announced by George J. Stoneman, president of the company, that the erection of the 50-ton cyanide plant will be delayed and that \$50,000 will be spent immediately in developing the lower levels of the mine. It is hoped that the development will justify the erection of a 100-ton plant the latter part of 1921. Milling tests on the ore have been made by the General Engineering Co. of Salt Lake City and the plans for the mill are complete. The Stargo Mines, Inc., has shipped high-grade silver-gold ore continuously for 15 months to the smelter at Douglas. The stockholders of the company are residents of Arizona.

The Sierra De Oro Mining Co. has been sold at Sheriff's sale to D. M. Potter for \$22,338 and costs. This property consists of 17 patented claims and a large acreage of patented and unpatented land on the San Francisco river, including water-rights and placer deposits, and adjoins the Copper King property of the Phelps Dodge Corporation. The development consists of a 2000-ft. tunnel which if continued should cut the vein system at a depth of approximately 1000 ft. below the outcrop.

JEROME.—The Jerome Superior Copper Co. has been closed down since December 13 and the shaft allowed to fill with water to the 700-ft. level. A legal fight for control of the company has been launched by a group of Los Angeles stockholders who filed complaints with the Arizona Corporation Commission charging George Mitchell, manager, and M. P. Frasier, president, with mismanagement. The Commission in its filing upon the case has urged the stockholders to settle their difficulties and called attention to a provision of the civil code charging the Commission to communicate with the attorney-general to apply to the courts for the appointment of a receiver where it appears that the business of an investment company is being conducted in an unsafe and unauthorized manner.

KINGMAN.—Drifting toward the ore-shoot on the 350-ft. level of the I.X.L. mine is now under way, the station and sump having been completed a few days ago. The ore opened on the upper levels has been sufficiently plentiful to warrant confidence in continuation at depth. The I.X.L. vein is reported as being the largest in the district, being 40 ft. wide in some places. Very rich ore is reported as having been opened in a winze on the 185-ft.

level of the Golden Star mine at Mineral Park. A recent shipment of ore to the Humboldt smelter yielded satisfactory returns and shipments will be continued. A large tonnage of good mill-ore is reported as having been opened.

MIAMI.—Full operations at the Van Dyke Copper Co. are now to be resumed as a result of the increased power recently made available by the local power plant. During the past two months only sufficient power to keep the mine open has been at hand. Lateral exploration is to be continued at two horizons; at the 1220-ft. level where the station and ore-pocket have been cut and 150 ft. of drifting has been done; and at the 1550-ft. level where only 50 ft. of drifting has been done. All this work has been done in the two ore-horizons indicated by the shaft and diamond-drill work. The upper ore-zone is copper carbonate and the lower is disseminated chalcocite. It is the policy of the company to push development work at both levels.

OATMAN.—Since the connection by the United American with the Tom Reed drift on the Aztec vein a station is being cut in the ore-shoot preparatory to sinking a winze to prove the depth of the ore recently opened. It is reported that this orebody is 300 ft. long and 30 in. wide and will average about \$100 per ton in gold.

PRESCOTT.—The Howard Copper Co. has acquired a two-thirds interest in the Olive, South Extension of R & H, and Alice claims from J. J. Fagan of Phoenix, trustee for the owners, for \$70,000. The claims are situated in the Black Canyon district. While undeveloped the claims are said to be promising prospects.

SUPERIOR.—It is reported that as a result of the recent visit of Messrs. Stephen, McKay, Smith, and Defty, the promoters of the Queen Creek Copper Co., new and more powerful machinery for development work is to be installed. Arrangements for power have been made with the Superior Light & Power Co. The ore of the Queen Creek mine carries gold and copper, and development, which has been under way for several years, is reported to have opened a considerable quantity of ore.

MICHIGAN

CALUMET & HECLA.—COPPER RANGE.—QUINCY.

HOUGHTON.—November production figures for the Calumet & Hecla group of mines shows a decrease of 616,739 lb. from the October total. While the curtailment program became effective November 16, several

weeks elapsed before the new schedule became fully operative and the results will not be noted until the December figures are announced. November production was 7,426,763 lb. of refined copper. It is estimated that a decrease of at least 1,000,000 lb. will be revealed by the December figures, due to the closing of Osceola, Allouez, LaSalle, and White Pine.

Copper Range will close the year with finances and copper on hand about the same as at the end of 1919. It is expected that production for December will show a slight increase due to additional men employed at all three mines, Champion, Baltic, and Trimountain. The yield from these mines shows no material change from month to month and the average for the year will be about on a par with that of last year. Champion rock averages about 36 lb. of refined copper per ton, Baltic about 33, and Trimountain 24. Costs are estimated about 15c. per pound and at the present price of copper the property cannot do much more than break even. Normally, Copper Range should produce copper at about 10c. per pound. The company has no fixed policy in regard to 'openings', but keeps well ahead of immediate requirements. During the period of curtailment, openings will be vigorously extended and the property placed in the best physical condition to meet increased production when the market strengthens. Copper Range finds that its mechanical devices are operating satisfactorily and it is expected they will make a material difference in costs, at the same time making possible a greater output. The introduction of mechanical scrapers and shovels, in fact, is the biggest accomplishment of the year in the Lake district.

Repairs have been completed in No. 4 shaft, Wolverine, and the mine is again 'hitting its stride' in production. Output for the past week has been averaging 900 tons per day. No. 4 shaft was out of use for several weeks to permit the replacing of concrete supports by timber between the 30th and 32nd levels. The shaft-pillars in this part of the property are being removed from the 38th level upward, and the yield per ton in refined copper is holding near 17 lb. The removal of arches and backs of stopes, and the widening out of drifts to both walls of the vein, continue. The showing in No. 3 shaft is favorable and the result will be a material increase in copper output this month. 'Rock' shipments now are sufficient to keep two heads in the Wolverine mill in continual operation.

In its No. 2 shaft, Quincy is penetrating territory, south and under the shaft, acquired from the Hancock Consolidated in 1915. The lode is uniformly mineralized and rich in mass and barrel copper. The new shaft recently put in operation at No. 2, with a hoisting capacity of 13,500 ft., will materially aid in the deeper development of this shaft and lengthen its life a great many years. Production of the mine is now on a 60% basis and there will be no further curtailment. Production for the year will show a considerable falling off from that of 1919. During the early months of the year the property was affected by a shortage of labor, a con-

dition which prevailed throughout the district, and of late months the low metal market has contributed to a lessened output. Last year Quincy produced 19,476,770 lb. of refined copper, over 2,000,000 lb. less than normal. Quincy, however, is in a position to readily take advantage of an advance in the price of copper. It has openings in excess of 100 miles in ground that will average 17 lb. of refined copper per ton, and in at least two shafts, No. 2 and 8, the 'rock' is increasing in copper content. Improvements in hoisting-equipment, underground electric haulage, new re-grinding machinery, increased capacity of stamp-heads, reduction of loss in tailing, and extensive changes in the smelting-plant will enable the management to quickly increase production when needed and contribute to a lessening of costs.

NEVADA

MILLING PLANT PLANNED FOR THE EUREKA CROESUS.

EUREKA.—The Eureka Croesus produced to June 1 of this year from new workings, 4814 tons of ore of a gross value of \$311,806, or \$64.47 per ton, according to a report to stockholders written in September and made public now. The metallic content per ton was 0.68 oz. gold, 24 oz. silver, and 16% lead. Freight and treatment charges totaled \$10 to \$19 per ton. The cost of mining was \$93,904 and the operating expense \$85,194. "The greatly increased cost of labor, freight, machinery, supplies, and material of every kind makes necessary the erection at the mine of a plant for treating medium and low-grade ore," says the report. A method has been perfected for treating this ore, "of which we have enough to keep a plant in operation for years". The directors have authorized the sale of \$1,500,000 worth of additional treasury stock to finance the plant.

MANHATTAN.—The report of W. L. Taylor, general superintendent of the White Caps, covering operations from May 13 to December 9, shows that 1955 ft. of development work was done during the period. Mr. Taylor says that work on and between the 600 and 800-ft. levels in the east orebody "indicates a probable tonnage of 15,000 to 20,000 tons of ore of an average value of about \$18 per ton". A cross-cut to a faulted segment of the White Caps limestone on the 550-ft. level has exposed ore 41 ft. long, 12 ft. wide, and assaying \$22.90. The report says work is being done in this territory in a search for other orebodies and that, when this has been completed, work will be done to explore these bodies on the 310 and 800-ft. levels, which are 700 ft. apart on the dip of the vein. When this orebody has been opened on the 800 and 310-ft. levels the company should be able to resume milling at a profit, according to the report. It is expected to complete the work by June 1 of next year. The largest business houses in Manhattan were burned recently with a loss estimated at \$30,000. The mines were not damaged.

DIVIDE.—A meeting of stockholders in the East Divide has been called for January 15 to consider increasing the capital stock from 1,500,000 to 2,000,000 shares, the ad-

ditional stock to be sold and the funds to be used for further work. The company, from the bottom of a 400-ft. shaft, has done 1400 ft. of lateral work since October 1918. The main cross-cut, driven east, is 645 ft. long, with north and south drifts at the 480-ft. point. The south drift, on the foot-wall of a vein 45 ft. wide, has been driven 245 ft. Important results have not been obtained, but general conditions are regarded as justifying much further work. The south drift is to be continued, the vein in which it is driven to be prospected at a depth of 200 ft., and sinking of the shaft may be resumed.

CUPRITE.—The Foster Mines Co. has leased for 50 years 300 acres containing a silica deposit and, starting

tremely fine dust will settle. The tube and tower will contain boxes into which the various grades will settle, the finest being farthest from the blower. The Hardinge mill will be used to grind the coarser air-floated material in the tube so as to produce quickly the finer grades when there is a demand for them exceeding the production direct from the crusher product. Various grades of silica are used in many industries and the latest use for it is in the manufacture of 'woodstone', made by mixing wood pulp, silica, and cement. This is used in making sinks and similar articles. Silica also is used in making brick, for abrading purposes, as a wood filler, in the manufacture of porcelain, paints, scouring-soap, and in making art-glass, pottery, fused-silica ware, and as an



COAL MINES OF THE UTAH FUEL CO. AT CASTLE GATE, UTAH

on a small scale, Ernest D. Foster, manager, says he hopes eventually to ship 5000 tons of refined silica monthly. Belgian silica-sand of a grade that is used in the manufacture of glass is being laid down at San Pedro, California, for \$6.50 per ton, according to Foster, who says he does not expect to be able to compete with this until he can assure the railroads enough business to justify a lower freight-rate, but he does expect to be able to make a profit of \$5 to \$7 per ton on air-floated silica such as is used in the manufacture of paint. The deposit, 2½ miles from the railroad, is pure white, soft, breaks easily, with 25% going into 300 to 400-mesh material. He plans to erect a plant consisting of a crusher, wire-cloth screens, an 'air-flotation' machine, and a Hardinge conical 6-ft. silex-lined pebble-mill. The flotation machine, specially designed, will consist of a conical tube set horizontally, into which the fine silica will be blown from the smaller aperture after being crushed and screened, and a 30 or 40-ft. tower in which the ex-

insulator of electricity, for which it is far superior to glass.

UTAH

GENERAL SURVEY OF MINE PRODUCTION DURING 1920.

SALT LAKE CITY.—During 1920, the metal-mining companies of Utah paid the following dividends:

Cardiff Mining Co., Big Cottonwood.....	\$ 75,000
Chief Con. Mining Co., Eureka.....	353,692
Daly Mining Co., Park City.....	45,000
Daly West Mining Co., Park City.....	225,000
Dragon Con. Mining Co., Eureka.....	37,500
Eagle & Blue Bell Co., Eureka.....	311,605
Grand Central Mining Co., Eureka.....	42,000
Iron Blossom Mining Co., Eureka.....	50,000
Judge Mining & Smelting Co., Park City.....	180,000
Tintic Standard Mining Co., Eureka.....	469,880
Utah Apex Mining Co., Bingham.....	150,000
Utah Copper Co., Bingham.....	9,746,940

Total\$11,686,617

The mineral output of Utah during the past year was about the same as for 1919, in spite of a constantly declining market price for lead and copper. According to preliminary figures, the gold output of the State during 1920 was 82,750 oz., as compared with 104,464 oz. for the previous year. The output of silver is estimated at 11,839,621 oz., as against 11,619,961 oz. Had it not been for the Pittman Act, which stabilized the price of silver at \$1 per ounce, this figure for 1920 would have been considerably less. The copper production for 1920 is estimated at 115,000,000 lb., as compared with 124,061,087 lb. for 1919. Practically all of the copper produced in Utah during the past year came from the Utah Copper mine at Bingham; the output of this property being estimated at 5,800,000 tons, with a gross production of 106,500,000 lb. The lead output during 1920 is estimated at 146,002,000 lb., as compared with 123,829,051 lb. for 1919. The production of recoverable zinc will probably be about the same as for 1919, or about 4,500,000 lb. The four smelters in the State were in operation throughout the year, on a reduced basis. High prices for silver and lead during the early part of the year stimulated the mining of those metals, but with the out-law switchmen's strike in April and May, the smelters were unable to handle consignments, with the result that embargoes were placed on most of the large producers. This unfortunate condition existed for some time, with the result that operations were necessarily curtailed at the mines at a time when the metal markets were favorable to the operators. During the last six months of the year, with constantly declining prices for silver, lead, and copper, production began to fall off in every district in the State; and when freight-rates were increased on August 26, the smelters immediately increased their rates, which added a further hardship on the small producers. During the latter part of October, the Public Utilities Commission compelled all of the mining companies holding special contracts for power-service with the Utah Power & Light Co. to accept such service on schedule rates, which were from 50 to 100% higher than contract rates. As a result of this decision, the Judge electrolytic smelter at Park City, the only plant of its kind in the State, suspended operations. The new zinc-oxide plant at Murray will be ready for operation early in the new year, which will undoubtedly stimulate the mining of zinc ores in this State since the Grasselli Chemical Co. withdrew from the local field some months ago. At the close of the year, production of all the important metals is about at its lowest ebb, but as most of the large producers of lead and copper have been doing considerable development work during the past 12 months, their properties are in a position to increase output easily as soon as metal-market conditions justify.

A meeting of operators of lead mines in Utah was held at the office of the Utah Chapter of the America Mining Congress on December 21. A resolution was adopted, urging Congress to pass a higher protective tariff on lead. The present tariff is three-quarters cent per pound. Owing to the large stocks of the metal in

Europe, which was purchased from this country during the War, and attracted by the price of eight cents per pound some months ago, this metal started coming back to the United States. With lead at five cents per pound, even the largest producers in this State are having a hard time to make both ends meet, and the Utah Apex property at Bingham, the largest producer of the metal in the State, has closed down. The committee appointed to present the resolution to Congress was comprised of Ernest Bamberger, W. Mont Ferry, Fred Cowans, E. J. Raddatz, Imer Pett, and G. W. Lambourne.

EURÉKA.—With the payment of its dividend on December 23, the stockholders of the Tintie Standard Min-



MAP OF BRITISH COLUMBIA

ing Co. received a brief report, covering operations during the third quarter of the year. During that period there was shipped 31,090 tons, with a gross value of \$1,353,421, and after deducting freight and smelter charges, the net return was \$697,305. There was opened on the 1100-ft. level a large stope of ore, as well as one on the 1250-ft. level, while stope No. 5 on the 1200-ft. level is increasing in size and the ore in value. During the week ending December 18, the company shipped 69 cars of ore, approximately 3100 tons. This is the largest weekly output of ore from any one mine in the history of this district, the nearest approach having been 66 cars shipped by the Chief Consolidated in the early part of 1920. The Tintie Standard now has 275 men in its mine, the largest number in its career, while 125 men are engaged in the construction of the new milling plant at Warm Creek. The process to be used is identical with that in successful operation in the chloridizing-roasting plant of the Tintie Milling Company.

BRITISH COLUMBIA

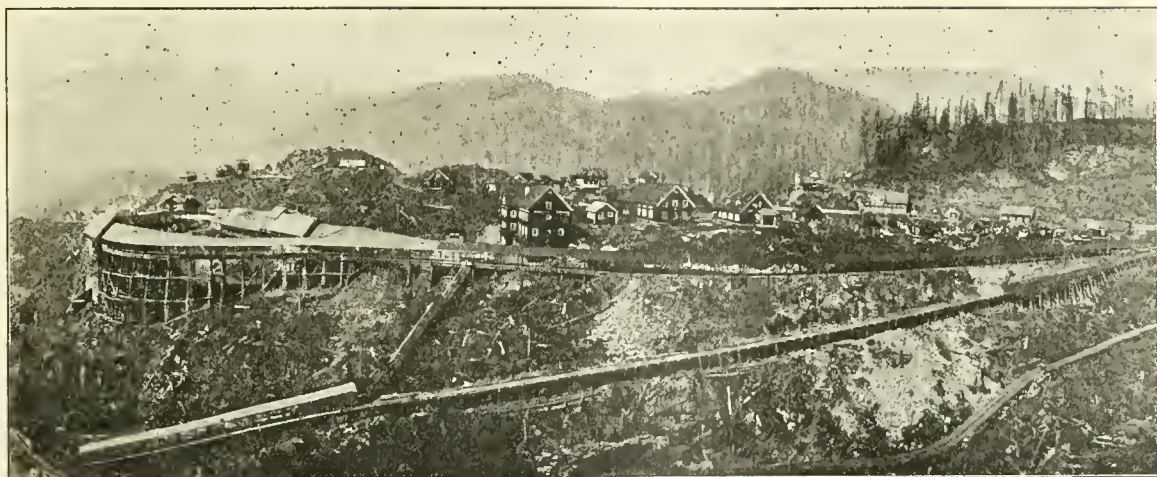
TRAFFIC ON THE DOLLY VARDEN RAILWAY SUSPENDED.—
TIDEWATER COPPER CO. MAKES FIRST SHIPMENT.

PRINCE RUPERT.—Heavy snowstorms closed the Dolly Varden-Alice Arm railway on December 16. About 27,000 tons of ore containing more than a million ounces of silver has been shipped from the mine. Though shipping has been stopped until next May, mining and development operations will be continued, and between 70 and 100 men will be employed. There was between three and four thousand tons of ore ready for shipment when the railway closed, and, as this quantity will be greatly increased during the winter, it is expected that the output of the mine next year will be nearly double that of the past year. The railway has been greatly improved during the past season, and its capacity has been practically doubled. The new hydro-electric plant was put into operation last week. This plant will supply both the Dolly Varden and the Wolf mines with power. The first unit has a capacity of 500 kw.; other units will

peared on the list for the first time this year with a shipment of 19 tons. The Josie mine, at Rossland, perhaps better known as Le Roi No. 2, closed down for an indefinite period on December 4. During the present year the mine has shipped nearly 12,000 tons of ore to Trail, and its closing cuts off practically the last supply of copper ore, except that received from the company's own Rossland mines, so the probabilities are that when the present supply of ore is smelted the copper department at the smelter will close.

GREENWOOD.—The Providence mine, which has been shipping on an average about 40 tons of high-grade ore per week to Trail, has been closed temporarily. A compressor has been purchased, and when this is in place it is thought that it will reduce the cost of mining sufficiently to justify re-opening the mine. The ore is rich in silver, and the slump in the price of that metal is the reason for closing the property.

ANYOX.—By a vote of 750 to 175 the employees of the Granby Consolidated Mining, Smelting & Power Co. decided to accept the new wage-rate offered by the com-



HIDDEN CREEK MINES OF THE GRANBY CONSOLIDATED CO., NEAR ANYOX, B. C.

be added as increased power is needed. Water-rights capable of developing 8000 hp. have been secured, and other mines in the district will be supplied with power. The Granby Consolidated M. S. & P. Co. has made a reduction of 75c. per day in its wage-scale. When working at capacity the company gives employment to more than 1000 men.

VANCOUVER.—The provincial branch of the Canadian Institute of Mining and Metallurgy will hold its spring meeting in this city on February 9, 10, and 11. H. Mortimer Lamb is chairman of the executive committee, which includes G. C. Mackenzie and R. W. Brock. A number of papers have been promised.

TRAIL.—The Consolidated M. & S. Co. continues to maintain the rate of output from its mines. Out of a total of 9093 tons of ore received at the smelter during the second week in December, 8126 tons came from the company's mines. The other important producers were: Bluebell, Riondel, 220 tons; Josie, Rossland, 285; and North Star, Kimberley, 165. Society Girl, Moyie, ap-

pany. H. S. Munroe told the men definitely when the proposal was put to them that the company could not carry on business under existing conditions at the present price of copper, and that in the event of their refusing to accept the reduction the plant would be closed. The new rate, which is a reduction of approximately 75c. per day, went into effect on January 1, and is to prevail for the first three months of the year, at the end of which the matter will be taken up again.

VICTORIA.—The Tidewater Copper Co., which is operating a property at Sidney Inlet, on the west coast of Vancouver Island, has made its first consignment of concentrate to the Tacoma smelter. The shipment comprises 400 tons and is valued at between \$20,000 and \$25,000. The Tidewater company has been operating for the last three years, and is said to have spent \$650,000 in development and plant. A considerable tonnage of ore has been demonstrated, which, it is stated, is sufficient to keep the plant operating at its present capacity for ten years. The ore contains about 2% cop-

per. and some gold and silver, the concentrate running \$3 to \$4 in gold and 5 to 7 oz. in silver. The whole plant is operated by water power, and consequently can be run cheaply. It is stated that it can produce copper profitably at present price of the metal. About 125 men are employed.

ONTARIO

PRODUCTION AT COBALT CURTAILED FURTHER.

COBALT.—Operations have been narrowed down at least 25% in the Cobalt district. The only complete shut down among the producers is the Temiskaming mine. This week, the Kerr Lake will discontinue production, but will carry on development work during the winter. The Dominion Reduction custom plant will curtail operations until spring, this plant having operated on ore coming chiefly from the Kerr Lake mine. Work has been started on the Haileybury Frontier property in South Lorrain, where an effort will be made to mine the deposits of cobalt which are found in comparatively wide veins. The property lies in the vicinity of the Keeley Silver mines, and the operators believe the cost of work will be offset to some extent by the recovery of some silver as a by-product. This is the first effort made to mine cobalt in this district other than as a by-product of the silver ores.

A winze at the 385-ft. level of the Chambers-Ferland mine has been sunk through the layer of slate in which the cross-cut lies and is expected to reach the underlying conglomerate formation this week. Veinlets found extending up into the slate and which contain some silver, are believed to have had their origin in a silver deposit in the conglomerate. Arrangements are being made to make a bond issue of \$35,000 on the Hudson Bay mines, the bonds to be supported by a mortgage on the property. The money is intended to finance operations until such time as shipments are resumed in the spring. Announcement is made that ore sufficient to warrant this plan is in sight. The shareholders will be asked to ratify the scheme this week. Heavy bullion shipments are being made from the Nipissing mine, a total of 561,216 oz. having been shipped during the first three weeks of December. The greater part of the metal has been consigned to Shanghai.

Preliminary estimates of the output of the silver and gold mines of Northern Ontario show a total of approximately \$23,295,088. The amount of gold produced exceeded the silver output, but the figures dealing with by-products appear to indicate a fair margin of total value in favor of the silver mines. Following is a summary:

Silver Mines	
Silver (9,931,143 oz.)	\$9,905,088
*By-products	1,800,000
Total	\$11,705,088

*The heavy demand and high quotations for cobalt was the reason for the high value of by-products from the silver mines.

Gold Mines	
Gold	\$11,500,000
By-products	90,000
Total	\$11,590,000
Total gold and silver	23,295,088

The silver mines of Cobalt and district have produced a total of \$191,701,275 since 1903. The gold mines, made up chiefly of those at Porcupine and Kirkland Lake, have produced \$59,879,262 since 1910. The combined total amounts to \$251,583,537.

Dividends Paid		
	1920	Total to date
Silver mines	\$3,458,142	\$81,975,040
Gold mines	3,240,042	18,785,280
Total	\$6,698,184	\$100,760,320

BOSTON CREEK.—A discovery of almost pure chalcopyrite has been made in the west cross-cut at the 500-ft. level of the main shaft of the Miller Independence. The mineral occurs in the form of a small solid vein paralleling a calcite vein. Assays in bulk show 32.48% copper together with \$2.80 gold and 1.3 oz. of silver per ton. A copper-bearing vein, showing on the surface, which has been traced for a considerable distance, has yielded assays of only 3 and 4%, but the new find indicates that copper deposition increases with depth.

PORCUPINE.—The report of the Porcupine Keora for the year ending December 1 states that No. 1 vein, 40 ft. wide on the surface, has been explored by diamond-drilling to the depth of 1000 ft. and gold content shown to be \$6 per ton. The manager reported, as the result of further drilling, the discovery of No. 5 vein with a width of 20 ft. and an average value of \$110 per ton, and No. 6 vein, having a width of 10 ft. with an average of \$46.50 per ton. Arrangements were made to sink a shaft to 250 ft. and run a cross-cut to open these veins. Three 40-acre lots adjoining the company's property to the north had been purchased, bringing up its total holdings to 200 acres. Development work is proceeding steadily.

MANITOBA

RAILROAD TO FLIN FLON PROJECTED.

THE PAS.—The Provincial government has announced, through Edward Brown, Provincial Treasurer, that, provided the Flin Flon syndicate will deposit one million dollars with the Government as an assurance that a smelter will be erected, and tonnage to pay a railroad supplied, the road now being surveyed from The Pas to the mine, will be built at the expense of the Province. It is understood that these terms will be accepted by the Flin Flon syndicate. The Federal government will, so Mr. Brown says, remit all taxes on copper for ten years, and not five as reported. This will be a very large undertaking. There are more than 20,000 tons of ore proved by shafts, drifts, and drill-holes, and the average value is supposed to be almost \$10 per ton. If the railroad is built it will be operated by the Canadian National Railways, that is to say, be part of the Federal railway system.

THE MINING SUMMARY

CALIFORNIA

Nevada County.—Despite the adverse conditions, increased clean-ups are reported in most of the producing gold mines of the district and the output is increasing each month. At the Empire, the operations are the largest in the history of that property and the North Star is also increasing its activities. The management of the latter mine has announced, however, that several months would be devoted to development and other dead work before any particular effort at large production was made. The producing mines here now include the Empire, North Star, Idaho, Maryland, Sultana, Alcalde, Grass Valley Boundary, and various small properties.—M. H. Brock, manager for the Grass Valley Boundary Mines Co., the newest company in the Grass Valley district, announces that the first clean-up at the mill has just been made and that the returns show approximately \$8.50 per ton. The milling was entirely on the dump, which was accumulated while the shaft was being sunk and drifts run, and is stated to contain a large amount of waste rock.

IDAHO

Coenr d'Alene.—Five thousand dollars for a 30-day option on 1,010,000 of the 2,000,000 shares of the capital stock of the Black Bear Mines Co. has been paid. The option has been filed with the county recorder by Robert McLaughlin. It was signed by Dennis Goggin and R. E. Weniger, two of the directors, and by J. L. Fitzgerald, secretary. If McLaughlin exercises the option he must pay 25c. per share for the stock. This places the value of the property at \$500,000. He agrees to pay on the purchase \$10,000 in the first six months and to start work in 60 days and do not less than \$5000 worth of work per month.—Wages of miners and muckers in the district were reduced \$1 per day on January 1. The 'going' wage beginning the first of the year will be \$4.75 per day. It was said that there will be little activity in the mines until spring. The only exception to the \$1 per day reduction is the Bunker Hill & Sullivan mine, which now pays \$5.25 per day, and will reduce its scale 50c., making the new wage \$4.75.—Additional men have been put to work by the Midnight Mining Co. to push the raise which is now up 400 ft. and has 700 ft. more to go.

MONTANA

Butte.—A general wage reduction throughout the Butte district will go into effect on January 20, those now receiving \$5.75 or over will be cut \$1, those now receiving under \$5.75 will be cut 75c. Single men are being laid off at nearly all of the mines.—The Butte-Plutus mine, which recently closed down owing to the inability to handle the additional water, has installed a new electric pump. It is understood that a contract has been let for the sinking of the shaft 50 ft., to the 400-ft. level, and driving a cross-cut to the New Mapleton, a distance of about 1500 ft.—Oscar Rohn, manager for the East Butte Co., states that unless the financial situation becomes so serious that the company cannot sell copper, or cannot borrow any money on the copper it is producing, there will not be any shut-down. If the East Butte should shut-down the Davis-Daly would necessarily follow, as the ore from its Colorado mine is treated at the East Butte smelter.

Helena.—Mining activity in this district is at a low ebb. The low price of lead has had a depressing effect generally. The concentrating plant of the New York-Montana Testing & Engineering Co. has closed until metal prices shall be better, and the East Helena plant of the American Smelting & Refining Co. has laid-off many men, and reduced wages for the same reason. Many of the mining men of Helena are now turning their attention to the new oil-fields in Fergus county. The Cat Creek field looks particularly promising, there being now ten producing wells in this field, with a combined flow of about 12,000 bbl. per day. The oil had a high gasoline content. Many wells are being drilled, and a great deal of activity is looked for in the spring. The oil-sands are penetrated at about 1600 ft. depth.—The Liver-pool mine in Lump gulch is maintaining regular shipments of silver ore to the East Helena smelter. About 30 men are employed. The mine has a 750-ft. shaft. The rich silver ore in the upper levels was worked out years ago, and the ore at present is being taken from stopes from the bottom level. The present operators have re-timbered the shaft, and installed electrical equipment, power being furnished by the Montana Power Co. The company plans to sink in the near future. Carl J. Trauerman is manager. Other Lump Gulch mines which are operating are the Little Nell, Free Coinage, and Mammoth. These properties are developing. There is some activity in the Nigger Mountain region, south of Elliston. The Charter Oak has a shipment nearly ready and the Big Dick and the Julia are developing. The Monarch mine on Bison mountain is closed for lack of funds to complete the development work. The property is well equipped with steam-driven compressor, drills, saw-mill, bunk-houses, and boarding-house.

Neihart.—The old Barker or Wright & Reynolds mine is producing some rich silver-lead ore, according to reports. The ore is being shipped to the railway by motor-trucks. T. C. Power, of Helena, owner of the property, is reported to have recently refused an offer of \$1,000,000 for the mine.

PERU

Cerro de Pasco.—The net income for the Cerro de Pasco Copper Co. for 1920 will be approximately \$4,000,000. This does not include undistributed profits of subsidiary companies, which have averaged approximately \$1,000,000 annually for four years ended December 31, 1919. Notwithstanding increased production during the war period, ore-reserves are considerably larger than when the company was organized. In addition to copper ore-reserves, engineers estimate a large deposit of oxidized silver and pyritic silver ore, assaying from 8 to 18 oz. per ton. Preliminary reports estimate the available quantity of this ore in excess of 100,000,000 tons. Of this, about 18,800,000 tons are definitely reported and contents calculated at over 200,000,000 oz. of silver.

In 13 years ending December 31, with 1920 partly estimated, the company has produced 660,799,611 lb. of copper, 45,904,700 oz. of silver, and 292,825 oz. of gold. Silver production in ounces for the last five years, with 1920 estimated, has been as follows: 1916, 4,209,659; 1917, 5,556,735; 1918, 5,051,900; 1919, 5,325,320; 1920, 5,595,084.

PERSONAL

The Editor invites members of the profession to send particulars of their work and appointments. The information is interesting to our readers.

F. W. Draper is here.

J. M. Campbells has gone to Rangoon, Burma.

J. R. Flubay is now residing at Redlands, California.

Millard K. Shaler is returning from the Congo to Brussels.

J. F. Grugan is on his way from New York to the Transvaal, in South Africa.

Albert Roberts has returned to San Francisco from a visit to the South-West.

V. Harper Carter, a mining engineer from Platteville, Wisconsin, is at Oakland.

Walter Fitch Jr., of Eureka, Utah, is spending the holidays in southern California.

C. E. Mills, head of the Apache Powder Co., has been visiting the Bisbee district, Arizona.

W. E. Thorne has returned to Santa Cruz, California, from Nigeria. He expects to return thither in April.

Julien Raick, a graduate of the university of Liège, is taking a post-graduate course in mining at Stanford university.

S. M. Parker was in San Francisco last week on his way from Corinto, Nicaragua, to Morgan Hill, California, where he will reside.

Frank E. Grant, superintendent of steam-shovel mines for the Nevada Consolidated Copper Co., is here from Ruth, Nevada.

Victor C. Alderson, president of the Colorado School of Mines, passed through San Francisco last week on his way to Los Angeles.

Hervey Gullick left India in the middle of November, and will reach San Francisco in February, after having visited Manila and Honolulu.

H. H. Claudet has taken over the Ottawa branch of the General Engineering Company and will conduct that office and laboratory on his own account.

Gelasio Caetani was elected a Councilman at the head of the poll of Rome, but he did not see his way to accept the mayoralty, for which he had been nominated.

Clinton W. Bagwill, for the past 10 years chief clerk at the mill and smelter of the Nevada Consolidated Copper Co., at McGill, Nevada, has resigned. On January 1 he became associated with the Granby Consolidated company in British Columbia.

John M. Hayes, whose resignation as treasurer of the Utah Copper Co. became effective on January 1, was tendered a farewell dinner party at the Alta Club at Salt Lake City on December 22. C. T. S. Parsons, assistant cashier of the company, has been promoted to the position of cashier.

Thomas M. Skinner Jr., consulting metallurgical and chemical engineer of Douglas, Wyoming, is covering extensive research and examination work upon some of the natural deposits of California, including Owens Lake, at which place he installed a caustic soda and potash plant during the War.

Obituary.

Benjamin Holt, president of the Holt Manufacturing Co., died at Stockton, on December 5. He had always been a man of great vigor, fond of hard work, and up to his last illness, had been constantly engaged in inventive and creative work connected with 'Caterpillar' tractors. Holt combined harvesters, and other machines originally invented by him. He was born in Merrimac county, New Hampshire, on January 1, 1849. His early education was in the public schools, later attending an academy at Tilton, New Hamp-

shire, and a Baptist institution at New London. The Holt Manufacturing Co. was incorporated at Stockton in 1892. Benjamin Holt was the inventive genius of the organization, and his name has become known throughout the world as a pioneer and leader in the design, invention, and building of new, important, and vital types of agricultural and road machinery. He invented the self-propelled combined harvester, a combination of tractor and harvester, the most effective grain-handling machine ever built. From the necessity of providing a surer traction for soft soils, Benjamin Holt gave the world his master invention, the track-laying type of tractor bearing his name, and now known the world over by the Holt trade-mark 'Caterpillar'. The world-wide prominence into which 'Caterpillar' tractors came over a decade ago, brought about the establishment of the Peoria factory in 1909, and Benjamin Holt was intensely interested in everything pertaining to the development of this big insti-



Benjamin Holt

tution as well as the parent plant at Stockton, California. Due to his pioneering work, the 'Caterpillar' was established as a commercial success and was available for military needs with the outbreak of the War in 1914, when it was adopted by the allied governments from among all the world's tractors for artillery and supply transportation. Those tractors brought about the creation of 'tanks', and Benjamin Holt has been given official credit by governments, and by the public everywhere, as the inventor of the 'Caterpillar' tractor which made the tanks possible. As time passes, and the great forces of the War are seen in their true perspective, the world will feel it owes a particular debt of gratitude to Benjamin Holt, whose inventive skill and genius brought the 'Caterpillar' and the 'tanks' into existence. Benjamin Holt, however, never conceived the building of a military machine as such, but invented the 'Caterpillar' tractor, and strived constantly to improve it, for everyday farming and road use. He was a respected citizen, an honored Californian, and an inventor whose ingenuity proved of value to the entire world.



METAL PRICES

San Francisco, December 28

Aluminum-dust, cents per pound	65
Antimony, cents per pound	7
Copper, electrolytic, cents per pound	14
Lead, pig, cents per pound	5
Platinum, pure, per ounce	\$85
Platinum, 10% iridium, per ounce	\$125
Quicksilver, per flask of 75 lb.	\$50
Spelter, cents per pound	8
Zinc-dust, cents per pound	12.50—15.00

EASTERN METAL MARKET

(By wire from New York)

December 27.—Copper is inactive but easy. Lead is stagnant and lower. Zinc is dull and declining.

SILVER

Below are given official or ticker quotations for silver in the open market as distinguished from the fixed price obtainable for metal produced, smelted, and refined exclusively within the United States. Under the terms of the Pittman Act such silver will be purchased by the United States Mint at \$1 per ounce, subject to certain small charges which vary slightly but amount to approximately three-eighths of one cent. The equivalent of dollar silver (1000 fine) in British currency is 46.65 pence per ounce (925 fine), calculated at the normal rate of exchange.

		New York	London	Average week ending	
		cents	pence	Cents	
Date					Pence
Dec.	21	62.50	40.00	Nov. 15	80.02
"	22	63.25	41.50	" 22	76.41
"	23	63.50	40.62	" 29	73.72
"	24	65.37	42.00	Dec. 6	69.08
"	25 Holiday			" 13	62.54
"	26 Sunday			" 20	63.77
"	27	64.25	Holiday	" 27	63.77
Monthly averages					
Jan.	1918	1919	1920	Jan.	1918
Dec.	88.72	101.12	132.77	July	99.62
Feb.	85.79	101.12	131.27	Aug.	100.31
Mch.	88.11	101.12	125.70	Sept.	101.12
Apr.	95.35	101.12	119.56	Oct.	101.12
May	99.50	107.23	102.69	Nov.	101.12
June	99.50	110.50	90.84	Dec.	101.12

COPPER

Prices of electrolytic in New York, in cents per pound.

Date			Average week ending				
Dec.	21	13.50	Nov.	15	14.87		
"	22	13.25	"	22	14.63		
"	23	13.00	"	29	14.15		
"	24	13.00	Dec.	6	13.63		
"	25 Holiday		"	13	14.00		
"	26 Sunday		"	20	13.71		
"	27	13.00	"	27	13.15		
Monthly averages							
	1918	1919	1920		1918	1919	1920
Jan.	23.50	20.43	19.25	July	26.00	20.82	19.00
Feb.	23.50	17.34	19.05	Aug.	26.00	22.51	19.00
Mch.	23.50	15.05	18.49	Sept.	26.00	22.10	18.75
Apr.	23.50	15.23	19.23	Oct.	26.00	21.66	16.53
May	23.50	15.91	19.05	Nov.	26.00	20.45	14.63
June	23.50	17.53	19.00	Dec.	26.00	18.56	...

LEAD

Lead is quoted in cents per pound, New York delivery.

Date			Average week ending			
Dec.			Nov.			
	21	4.60		15	0.61	
"	22	4.45	"	22	6.44	
"	23	4.45	"	29	5.67	
"	24	4.45	Dec.	6	5.24	
"	25 Holiday		"	13	5.00	
"	26 Sunday		"	20	4.82	
"	27	4.45	"	27	4.48	
Monthly averages						
Jan.	1918	1919	1920	1918	1919	1920
Feb.	6.85	5.60	8.65	July	8.03	8.63
Mch.	7.70	5.13	8.88	Aug.	8.05	9.03
Apr.	7.26	5.24	9.22	Sept.	8.05	8.08
May	6.99	5.05	8.78	Oct.	8.05	7.28
June	6.99	5.04	8.55	Nov.	8.05	6.37
	7.59	5.32	8.43	Dec.	6.90	7.12

TIN

Prices in New York, in cents per pound.

Monthly averages							
	1918	1919	1920		1918	1919	1920
Jan.	85.13	71.50	62.74	July	93.00	70.11	49.29
Feb.	85.00	72.44	59.87	Aug.	91.33	62.20	47.60
Mch.	85.00	72.50	61.92	Sept.	80.40	55.79	44.43
Apr.	88.53	72.50	62.17	Oct.	78.82	54.82	40.37
May	100.01	72.50	64.99	Nov.	73.67	54.17	36.97
June	91.00	71.83	48.33	Dec.	71.52	54.94	...

ZINC

Zinc is quoted as spelter, standard Western brands, New York delivery. in cents per pound.

Date		Average week ending			
Dec.	21	5.75	Nov. 15	6.86	
"	22	5.60	" 22	6.66	
"	23	5.50	" 29	6.25	
"	24	5.50	Dec. 6	6.14	
"	25 Holiday		" 13	6.42	
"	26 Sunday		" 20	5.89	
"	27	5.45	" 27	5.56	
Monthly averages					
Jan.	1918	1919	1920	Jan.	1918
Feb.	7.78	7.44	9.56	July	8.72
Mch.	7.97	6.71	9.15	Aug.	7.78
Apr.	7.07	6.53	8.93	Sept.	8.33
May	7.04	6.49	8.76	Oct.	9.58
June	7.92	6.43	8.07	Nov.	7.57
	7.92	6.91	7.92	Dec.	7.83

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, according to quantity. Prices, in dollars per flask of 75 pounds.

Date			Dec.	14	55.00
Nov.	30	55.00	"	21	50.00
Dec.	7	55.00	"	28	50.00
Monthly averages					
Jan.	1918	1919	1920	Jan.	1918
.....	128.06	103.75	89.00	.....	120.00
Feb.	118.00	90.00	81.00	.....	100.00
Mch.	112.00	72.80	87.00	.....	103.00
Apr.	115.00	73.12	100.00	.....	102.60
May	110.00	84.80	87.00	.....	86.00
June	112.00	94.40	85.00	.....	78.00
				.....	71.00
				.....	56.00
				.....	115.00
				.....	95.00

THE EDGE BANK AND FOREIGN TRADE

Objections to the formation of the \$100,000,000 bank, under the Edge Act, are largely due to misunderstanding of its objects, powers, and modus operandi. Many exporters and business men are under the impression that the Edge Bank will lend up to \$1,000,000,000 to exporters, farmers, manufacturers, etc.—in fact, anybody or any corporation that may want a long-time credit. This, of course, is not the purpose. Although it has broad powers, bankers say its principal business will be confined to issuance of debentures, bonds, and promissory notes designed primarily to promote international business.

Fear that securities might be offered that are not adequately protected, appears unfounded. The law provides that each issue of debentures, etc., must be submitted to the Federal Reserve Board for approval before it may be offered. Bankers believe no better guarantee could be offered the investor. They point out that the Federal Reserve Board has been severely criticized for its conservative regulations, but never for taking improper risks. Therefore, when the Reserve Board approves an issue, the public need have no hesitancy in investing, with entire confidence in the soundness of the security.

A banker who thinks the new bank will be one of the most constructive forces in the business world says: "The new bank will be the most powerful factor in the export business. It will be big enough to command the best brains in the country. It will have stockholders all over the country. Every State will be represented. Every stockholder will be a 'booster' for the loans, and probably most of the subscribing banks will be selling agencies. It will, therefore, represent the most efficient selling force for investments ever organized in peace times."

"The new institution is not being organized to benefit any one business or section. Its favorable influence will be felt in every community in the United States. It will be felt, in a limited way, the world over. Not a country but needs some assistance. Germany needs low-grade cotton, copper, etc., in large quantities. The objection that the allies have a prior lien on all Germany's productive powers is not sound. If we supply the raw material, there is no good reason why we should not be absolutely protected, because there is no other way Germany can produce a surplus to pay her debts. If the Allies prevent Germany from getting raw material they will themselves make it absolutely impossible for Germany to pay any indemnity, and they know it very well. Their only hope lies in the renewal of prosperity in the one-time Empire."

"The export situation, with regard to South America, shows no improvement. South Americans want our goods and have ample security to give us, but under present conditions we have no adequate facilities for financing long-term credits. Practically all efforts of the Edge bank will be directed toward correcting this deplorable export situation, because the law provides that 'it cannot conduct business within the United States except as incidental to international business'. This is a time for co-operation. Every bank in the country should do its share toward bringing export business back to 'normalcy'. They can do that by promptly subscribing to the stock and then by 'putting their shoulders to the wheel' setting business moving again."

MONEY AND EXCHANGE

Foreign quotations on December 28 are as follows:

Sterling, dollars:	Cable	3.50 3/4
	Demand	3.51 1/2
Francs, cents:	Cable	5.85 1/2
	Demand	5.87 1/2
Lire, cents:	Demand	3.36 1/2
Marks, cents		1.41

Eastern Metal Market

New York, December 23.

The markets are all without feature or activity and the price tendency is downward.

Odd lots of copper are going at concessions but real active demand is absent.

The tin market is nominal in the absence of any business, real or speculative.

Lead has again declined to new low levels for the year.

Zinc has receded to nearly the level of three or four weeks ago.

Antimony is quiet and unchanged.

IRON AND STEEL

The relation between the Steel Corporation's scale of operations and the average of leading independent companies has not changed from 85 to 90% for the former and 40 to 70% for the latter. There is wide variation in the activities of independent producers, the smaller companies faring worse. Some of the latter have a complete shut-down, but would start up on the accumulation of a few days' orders. The estimate of a 50% average at independent mills in the first quarter of the new year is not uncommon.

Definite announcements of wage reductions have been made at Johnstown and Coatesville, Pennsylvania; Wheeling, West Virginia; and Buffalo; generally about 20%, with elimination of overtime. No reductions have been made at Chicago or at Youngstown thus far, but January will bring many announcements.

The amount of new business coming to the books of the mills is under-estimated in some current reports. Naturally, it is for early delivery, but so many consumers and dealers are running on small stocks that producers continue to hear from them. Such week-to-week buying is to be expected for some months.

The blowing-out of blast-furnaces continues, seven or eight stacks being reported this week that have just stopped or will be out by the end of the year.

Welch makers of tin-plate are negotiating for a large Canadian order, according to our cable advices. British prices for ship-plates, boiler-plates, and steel hoops have been reduced. Business is at a low ebb throughout the British industry.

COPPER

The market continues very dull. There are frequent sales of small quantities to Europe and foreign countries, but domestic demand is exceedingly light and is being satisfied by a few producers or dealers who need the cash. One sale of 500 tons of electrolytic is noted at 13.50c., New York, for early delivery. It is stated that as low as 13c. can be done easily for December. Large producers are quoting 14c., New York, but will sell under this if a desirable order is presented for early delivery and for the entire first quarter, but not for March only. Lake copper is nominal at 13.75c., New York, for early delivery, but there is no demand. Consumers are not buying as the year closes and no purchasing on any scale is looked for until some time in January. It is the conviction of some in the trade that prices higher than 14c. will not be realized for some months at least.

TIN

The authorities in the Federated Malay States have again and for the third time in less than three weeks fixed a minimum price for tin, this time at an equivalent of £236 c.i.f., New York, as against £243 a week ago and £226 in the first instance. These changes have unsettled the market here and made a bad situation worse. Consumers and dealers as well as importers are in the dark as to what the Far Eastern gyrations mean. Consumers and dealers remain out of the

market and outside of the transactions noted a week ago on the New York Metal Exchange, there has been no business and prices are nominal. Yesterday spot Straits was quoted at 34c., New York, around which level it has hovered the whole week. The London market is lower with yesterday's quotations at £205 5s. for spot standard, £210 for both future standard and spot Straits, all of which are £6 to £7 lower than a week ago. Arrivals thus far this month have been 2385 tons with 1925 tons reported afloat.

LEAD

The American Smelting & Refining Co. late on Monday again reduced its price to more nearly conform to the outside market; the price is now 4.75c., both New York and St. Louis, against 5c. last week. The outside market has generally receded until yesterday lead for early delivery was obtainable and had sold at 4.60c., New York and St. Louis. The parity of the two districts is due to the possibility of competition of imported lead because of the weakness in the London market. There has been some buying since this market reached the 5c. level, but the volume has not been heavy. It is admitted that so far as stocks are concerned lead is in a better position than copper or zinc.

ZINC

The London market has measurably weakened in the last week or 10 days and this has had its effect here. Prices have declined until the New York and St. Louis quotations are again on a parity, due to the fact that foreign zinc has been offered as low as 5.70c., seaboard, duty paid. The imported zinc is not so much of a factor in this market as in the case of imported lead because some buyers prefer not to use it. Consumers are not buying nor are producers selling at present below-cost prices except where and when necessary. An upturn in the London market is looked for soon, in responsible quarters here, as stocks are not large and are in strong hands. We quote the market for prime Western for early delivery at 5.75c., New York and St. Louis, with domestic metal bringing 6.25c., eastern delivery.

ANTIMONY

This market is dull and unchanged with wholesale lots for early delivery quoted at 5.50c., New York, duty paid.

ALUMINUM

The leading maker's quotation for wholesale lots of virgin metal, 98 to 99% pure, is unchanged at 32.90c. f.o.b. producer's plant, while the same grade, largely of foreign origin, is quoted at 23 to 25c., New York.

ORES

Tungsten: The market is devoid of interest or activity, inquiries being limited to small proportions and resulting in no business. Quotations are nominal at \$4 per unit for Chinese ore and at \$4.50 per unit for Bolivian. The ferro-tungsten market is inactive and unchanged.

Molybdenum: There is no business and no prices are available.

Manganese: In the absence of any demand to test the market, high-grade ore is quoted nominal at 40c. per unit, seaboard, but it is believed that 35c. per unit could be done.

Manganese-Iron Alloys: There has been no real test of the ferro-manganese market where quotations are nominal at \$150, delivered, for the American product and \$170, seaboard, for the British, but it is confidently felt that a basis of \$125, seaboard, could be done. The British market is now at £33 per ton for export. Spiegel Eisen, 15 to 22%, is quoted at \$60, furnace, but it is probable \$55 could be done at least on re-sale material. There are a few inquiries for both alloys before the market.

Book Reviews

Lead. Including Lead Pigments and the Desilverization of Lead. By J. A. Smythe. 115 pp., ill., index. Sir Isaac Pitman & Sons, Ltd., New York and London. For sale by 'Mining and Scientific Press'. Price, \$1.

This is one of a series of small volumes on technical subjects, non-technically treated, that is being published by Pitman & Sons. The history of lead mining and smelting; the modern methods of treating the ores of lead; the uses of lead, its alloys, and its compounds are discussed in an entertaining and instructive way. It gives an excellent idea of the operations necessary in the production of lead without going deeply into chemistry and physics.

The Theory of Machines. By Robert F. McKay. Second edition. 431 pp., ill., index. Edward Arnold, London. For sale by 'Mining and Scientific Press'. Price, \$6.

This book is perhaps best described to the American engineer and mechanic by stating that it covers practically the same field as Smith and Marx's 'Machine Design', and in about the same way. It is well-written and well-illustrated. However, a foreign technical book, even one published in Great Britain like the present volume, must, at least in minor details, exhibit differences in nomenclature and practice from that current in America. Under such conditions, the American engineer, unless the foreign book is notably superior in other features, will usually prefer one 'made in America'. In considering the present volume, this is the only important drawback that we can see.

Pumping by Compressed Air. By Edmund M. Ivens. Second edition. 254 pp., ill., index. John Wiley & Sons, Inc., New York. For sale by 'Mining and Scientific Press'. Price, \$4.

The second edition of this book differs from the first, which appeared six years ago, in the addition of several illustrations and pages of text at various points. The book opens with a brief discussion of the general subject of pumping by compressed air, touching particularly upon various relatively uncommon methods. Then the air-lift and its application to pumping are considered, as well as the various commercial systems based upon it. Several chapters are also devoted to the hydraulic and thermo-dynamic theory upon which pumping by compressed air is based, and there are chapters discussing the compressor itself, and the design of an entire plant. The book will be useful to anyone engaged in pumping with compressed air.

Topographic Maps and Sketch Mapping. By J. K. Finch. Pp. 170, ill., index. John Wiley & Sons, Inc., New York. For sale by 'Mining and Scientific Press'. Price, \$2.50.

Interest in maps, and particularly topographic maps, has been stimulated, like interest in so many other subjects, by the War. The treatment in the present volume is non-technical and can be followed readily by the layman who has only the most elementary knowledge of mathematics. The book will be useful principally to two general classes of readers; first, men and women that use topographic maps but who do not know how to get the maximum benefit from them, and second, students engaged in learning to make a map that will be of maximum benefit to the user. The book is therefore appropriately divided into two main parts, Map Reading, and Sketch Mapping, besides a short additional chapter on Landscape Sketching. The discussion of map reading covers three chapters entitled, respectively, What a Topographic Map Shows, How to Get Certain Information from a Map, and Use of Topographic Maps in the Field. Part II, on Sketch Mapping, is similarly divided into Topo-

graphic Drafting, Flat Mapping, and Contour Mapping. The appendix contains a descriptive list of the principal topographic maps of the world, suggestions for a course in map reading and sketch mapping, and a bibliography, the first of the three divisions being particularly valuable.

Modern Welding Methods. By Victor W. Page. 278 pp., ill., index. Norman W. Henley Publishing Co., New York. For sale by 'Mining and Scientific Press'. Price, \$3.

The art of welding in its various branches has made such remarkable progress in the past few years that it has been difficult for the published matter to keep pace with it. The present volume may be said to be a very creditable attempt to catch up. After an introduction discussing the general features of the various methods of joining metals, the properties of the common metals are considered. The next three chapters are devoted to gas welding, considering in turn the gases used, the apparatus, and the general methods and technique. The next chapter considers electric welding, both resistance and arc, and the next thermit welding. Then comes a chapter on soldering and brazing processes, and the final chapter deals with forge-welding and with the heat treatment of steel. The book will be useful to anyone engaged in welding, directly or indirectly.

Practical Trade Mathematics. By James A. Moyer and Charles H. Sampson. 169 pp., ill., index. John Wiley & Sons, Inc., New York. For sale by 'Mining and Scientific Press'. Price, \$1.50.

If all our mechanics had a common-school education and our system of common-school education was really practical, there would be relatively little need for a book of this kind. Things being as they are, however, the book should be useful to many mechanics, who have come to realize their need of additional knowledge of mathematics. The book covers arithmetic and some plane geometry, but does not discuss either algebra or trigonometry. This latter appears to us to be a mistake. An explanation of the sine-bar, for instance, would have been welcome. Problems drawn from the practice of the various trades are used freely throughout the book to illustrate the discussion, and theoretical considerations are kept in the background as much as is feasible.

Powdered Coal as a Fuel. By C. F. Herington. Second edition. Pp. 324, ill., index. D. Van Nostrand Co., New York. For sale by 'Mining and Scientific Press'. Price, \$4.50.

Both the theory and the practice of the use of powdered coal have progressed so rapidly during the two years since the appearance of the first edition of this book as to justify a second edition, in which considerable new material has been added as well as the old material revised. After a general discussion of the burning of powdered coal, the various special applications are considered in detail, chapters being devoted to cement and lime kilns, annealing, air, and other furnaces, and core-ovens, as well as the use of powdered coal as a fuel under boilers for stationary, marine, and locomotive engines. The prevention of explosions, which, the author states, is entirely feasible, is also considered. A complete bibliography, both of books and of magazine articles, is included. The book will be useful to anyone who uses, or who is considering the use of, powdered coal.

Engineering Electricity. By Ralph G. Hudson. 186 pp., ill., index. John Wiley & Sons, Inc., New York. For sale by 'Mining and Scientific Press'. Price, \$2.50.

This book, as the preface states, "was written primarily for technical students not specializing in electrical engineering", but it would also be useful to many engineers, practising other branches of the profession, but feeling the need

of greater knowledge of electricity and its applications than they possess. The chapter headings, which give a general idea of the scope of the work, are as follows: Direct-Current Circuits; Electro-Magnetism; Electro-Magnetic Induction; The Direct-Current Dynamo; Direct-Current Measurements; Alternating-Current Circuits and Measurements; Three-Phase Currents; The Alternating-Current Transmission-Line; The Synchronous Generator; The Synchronous Motor; The Synchronous Converter; The Mercury-Arc Rectifier; The Transformer; The Three-Phase Induction Motor; and The Alternating-Current Series Commutator Motor. A useful feature of the book is a 40-page appendix of various kinds of electrical apparatus. Like so many technical treatises, its usefulness would be materially increased by the addition of a few pages giving definitions of every symbol used in the book and a collection of all the formulas derived in various parts of the text.

The Practice of Lubrication. By T. C. Thomsen. Pp. 602, Ill., Index. McGraw-Hill Book Co., Inc., New York. For sale by 'Mining and Scientific Press'. Price, \$6.

Few owners or operators of machinery realize the amount of loss possible through faulty lubrication and wrong selection of lubricating-oil. Those, however, who wish to have a basis for the study of their lubricating problems will find this book of great value. It begins with several chapters devoted to the various kinds of lubricants, including mineral, animal, and vegetable oils and greases, as well as graphite and other special lubricating mediums. Lubricating appliances and the various types of bearings are then considered. Then come several chapters on the lubrication of the principal kinds of machinery, a valuable feature of this part of the discussion being a set of lubrication-charts, one for each type of machine. Chapters are also devoted to oil recovery and purification, to oil storage and distribution, and to cutting-lubricants. In fact, the book is one of the most complete treatises on the subject that has appeared.

The Autobiography of Andrew Carnegie. 372 pp., Ill., Index. Houghton Mifflin Co. For sale by 'Mining and Scientific Press'. Price, \$5.

This is the life story of a remarkable man, written by himself in an easy conversational style, without either affectation or false modesty. He tells of his birth and childhood in his beloved Scotland and of the business disasters that impelled the family to start anew in America. His work as a telegraph messenger boy and then as an operator was the means of bringing him into contact with, and later into the service of, Thomas A. Scott, division superintendent for the Pennsylvania railroad. The well-known story of his assumption of authority during an emergency in Scott's absence, and without technical justification, is told, although he does not appear to attach so much importance to the incident as do some of his biographers, who appear to regard it as the turning point of his career. The years of his service with the Pennsylvania, broken for a brief period by his work for the Government as associate director of railroad operations during the Civil War, were marked by several promotions, and the way was open for further advancement. However, his railroad experience had convinced him of the possibilities of the iron industry, and a few ventures, started as a sideline, soon demanded his entire attention. At first his activities were confined to the rolling of rails and bridge-members, the former, in particular, being mainly imported from England at that time, the late 'sixties. Soon, however, the business expanded to the rolling of other products, and to the operation of blast-furnaces, iron-mines, and coke-ovens. It will be a surprise to most readers to learn that the Carnegie concern was the first in America to employ a chemist in connection with its blast-furnace operations. Amusing incidents are told of the mistakes of his competitors, who were

preparing their furnace-charges by rule-of-thumb, and who were paying high prices for ore shown by analysis to be of poor quality. Here we have one of the most important reasons for his success, namely, his determination to have the best machinery and the best methods, not only in the manufacturing but also in the accounting end of the business. What this latter meant in those days is indicated when he tells us that many of his competitors had no system of cost-accounting whatsoever. More important, however, in the success of the Carnegie companies was the faculty of their leader, which he so frequently mentioned, to gather about him more able men than himself, a statement that we cannot accept as strictly true if we believe that this very faculty shows the highest form of ability. A necessary complement of this faculty was the willingness to reward generously the men who worked with him. His attitude toward labor was unquestionably dominated by a desire to be fair, and he points with pride to the years of industrial peace at his plants, broken only by the Homestead strike. This strike was one of the great griefs of his life, and he devotes a chapter to a straightforward discussion of it, affirming his belief that on the main point at issue the men were wrong, while admitting that mistakes of judgment were made by the company. His retirement from the steel business, and his successful efforts to give away nearly, although not quite, all his money are described, together with a little discussion of some of his activities in the distribution of his wealth. As in most autobiographies, perhaps the most interesting feature is the glimpses of the writer's intimate friends, who included, in this case, such widely different men as Gladstone, Bryce, Matthew Arnold, John Morley, Herbert Spencer, Maline, Harrison, and Mark Twain, as well as many others. These reminiscences are enriched and enlivened by many anecdotes, of which we have space for only one. It concerns the German superintendent of the rolling-mills, William Borntraeger by name, who took a vacation for the purpose of going to Germany and bringing home a bride. When he started, Carnegie said, "I suppose your sweetheart is a beautiful tall young lady". Borntraeger replied, "Well, Mr. Carnegie, she is a little stout. If I had the rolling of her, I give her just one more pass".

Handbook of Building Construction. By George A. Hool and Nathan C. Johnson. In two volumes. Pp. 1444, Ill., Index. McGraw-Hill Book Co., Inc., New York. For sale by 'Mining and Scientific Press'. Price, \$10.

This is a book for the architect, the structural engineer, and the building contractor. It covers the design and construction of the principal kinds of buildings, from the smallest to the largest, of whatever material, and including the mechanical and electrical equipment. In the preparation of the material, the principal authors have been assisted by 46 engineers and architects, specialists in particular lines. The text is illustrated by a large number of line-drawings and many mathematical tables are included. The book is divided into three parts. Part I, on Design and Construction, is further subdivided as follows: Elements of Structural Theory, Designing and Detailing of Structural Members and Connections, Structural Data, General Designing Data, Construction Methods, Construction Equipment, and Building Materials. In Part II, on Estimating and Contracting, the chapter-headings are Estimating Steel Buildings, Estimating Concrete Buildings, Architectural Practice, Contracts, and Specifications. Part III, on Mechanical and Electrical Equipment, is divided as follows: Heating, Ventilating and Power, Water-Supply Data and Equipment, Sewage-Disposal, Waterless Toilet-Conveniences, Plumbing and Drainage, Electrical Equipment, Electric Lighting, Gas Lighting, Gas Fitting, Elevators, Mechanical Refrigeration, Communicating Systems, Lighting Protection, and Vacuum-Cleaning Equipment.



T. A. RICKARD, - - - Editor

IT appears that on December 22 the American Smelting & Refining Company, by Mr. Edgar L. Newhouse, made return to the petition of Mr. Eilers for a writ of mandamus. We find Mr. Newhouse's statement in the current issue of the 'Engineering and Mining Journal'. We reproduce it on pages 63 and 64 of this issue.

AT a time when a native of New York, of Spanish name and parentage, is described as the president of the Irish republic, it is amusing to note that the President of Mexico is stated to be the great-grandson of Michael O'Brien, an Irishman who became Miguel Obregon and then Obregon as soon as he had distinguished himself in the revolutionary war identified with the insurgency of Iturbide. Thus Alvaro Obregon is alleged to be the direct descendant of Mike O'Brien. Whether Mr. De Valera's pedigree leans on the Spanish or the Mexican side, we do not know, but General Obregon certainly looks Spanish enough to escape the suggestion of fitness to lead the Sinn Fein.

ESTABLISHMENT of a new metal-selling agency is announced by the firm of Guggenheim Bros. Henceforth the selling of the copper produced by the Utah, Chino, Ray, Nevada, Chile, Braden, and Kennecott companies will be in the hands of Guggenheim Bros. instead of being done by the American Smelting & Refining Company. The reason given is "a natural, if not inevitable, incident to the growth of industry". It is acknowledged that the Smelting company, in selling the copper of other companies, "had come to bear a responsibility greater than it was willing to assume". In any case, it was a responsibility that it had discharged with questionable success, if Mr. Karl Eilers is to be believed. Indeed, the announcement comes so soon after the disclosures made by him that the public is likely to make an inference not altogether complimentary to the gentlemen in control at 120 Broadway, New York.

IT was a pity that the President delayed his approval of the bill extending the time for assessment work; he signed it on the last day of the year. We received numerous telegrams from miners anxious to know what had been done. The text of the bill is as follows: "That the period within which work may be performed or improvements made for the year 1920 upon mining claims, as required under section 2324 of the Revised Statutes of the United States, is hereby extended to and including the

1st day of July, 1921, so that work done or improvements made upon any mining claim in the United States or Alaska on or before July 1, 1921, shall have the same effect as if the same had been performed within the calendar year 1920; Provided, That this act shall not in any way change or modify the requirements of existing law as to work to be done or improvements made upon mining claims for the year 1921."

GOLD MINING is discussed in several annual reports issued by officials of the Government. The Secretary of the Treasury says that the high cost of production has affected this industry unfavorably, but he thinks that as the purchasing power of the dollar increases, the production of gold will become remunerative. A Solomon verily! The Secretary of the Interior recommends an increased appropriation for geological investigations in Alaska to encourage the mining industry in that Territory. Alaska has had plenty of geological investigations and they have been among the best of their kind. The Governor of Alaska favors a premium on gold to be paid to the producer and remission of royalties on coal-lands for the first five years. The Chief of Engineers of the Army recommends an appropriation of a million dollars to begin a ten-year program of road construction for the purpose of developing the mineral resources of Alaska. The building of roads is a first-aid to mining development and if done sagaciously is well worthy of endorsement. The same official expresses the belief that the prosperity of Alaska rests on "the vigorous virile miner and prospector". As the wife of the Mayor of New York said to the King of the Belgians: "Sir, you said a mouthful".

DEPRESSING statements concerning mining are the fashion at present, just because some of our friends are long in timidity and short in memory. Times of depression alternate with periods of elation, contraction follows expansion, the economic pendulum seems to have its swing in obedience to a law as insistent as that of gravity. For a change, and to hearten our friends, we may mention that Ontario, a Canadian mining region of no small interest and consequence, yielded \$35,920,418 in metallic products during the first nine months of 1920 as against \$27,875,713 in the corresponding period of 1919. These statistics have been issued recently by the Department of Mines at Toronto. Gold mining seems to be alive, for the production was \$8,735,768 in

1920 as against \$7,571,586 in 1919—that is, for the respective nine months. The mining of silver likewise shows some liveliness, for the production increased from \$7,898,220 in 1919 to \$8,435,088 in 1920. Evidently mining in Ontario is not dead, nor even dying.

MANUFACTURERS of mining machinery and equipment in the United States are more than holding their own in competition with manufacturers in Great Britain so far as their sales to the mines of the Witwatersrand in South Africa are concerned. In 1913 we supplied only 9.52% of the manufactured goods imported into South Africa as compared with 56% by the United Kingdom. During the War our proportion increased as a result of Britain's inability to spare many commodities, but it was expected that the return of peacetime conditions would restore approximately the former ratio. Such has not been the case. Whereas America furnished 13.87% of South Africa's imports in 1918, the corresponding figure for 1919 is 24.14% as compared with only 45.46% from the British Isles. These data are in respect of all manufactured products, including those used in the mining industry, but the ratio is doubtless approximately the same, since the machinery and equipment required to supply 45 productive mines, with a monthly output of 2,000,000 tons, forms a considerable proportion of the total imports. In the current issue of the 'South African Mining and Engineering Journal', Mr. Francis Harrison, in discussing the matter from the standpoint of the mining industry, points out three factors that he says have militated against more extensive business with Great Britain. These are "the difficulty of getting supplies from manufacturers, high prices, and aggressive American competition". We presume that each of these factors must apply to separate groups of commodities; they certainly could not apply consistently to the same articles, unless perhaps the prices were only relatively high as compared with those quoted by Americans. In that event the last two would merge into one. The British manufacturer prides himself on "accurate and reliable British quality" as opposed to the "American style of cheap mass product". Statistics show that \$935,000 worth of rubber belts, principally for use in the gold mills, were exported from the United States to South Africa during 1919. This is only one item, but it indicates the importance of the South African market to the manufacturer in the United States, and particularly to the manufacturer of equipment for the mining industry. It also indicates that 'cheap mass production' may not be so bad after all. The engineer who is operating the mines on the Rand selects the belt that will give him the largest return for the money spent; he takes everything into consideration, the capital invested, the cost of current maintenance, and the length of life. Apparently a great many managers have discovered that the American-made belt is the best, their yardstick is net profit, the raw material from which dividends are made; for their ultimate object is dividends. Belting is one of a hundred things that are purchased; the Rand is one of a score of mining

districts that afford a market. As a matter of fact, the field is open and in the long run the country and the company with the best product gets the business. The American manufacturer owes it to himself to make his goods known abroad. Fortuitous circumstances frequently did this for him during the War; now he must do it through his own effort.

OUR curiosity is aroused by a small pamphlet that is being distributed by the United States Steel Corporation apropos of the recent report of the Interchurch World Movement on the steel strike of September 1919. If two short introductory letters, one to, and the other from, Mr. E. H. Gary, were disregarded; if sundry allusions to biblical episodes were deleted; and if the possessive pronoun "our" before "Interchurch Commission" were changed to 'the' in a number of places, we would conclude without hesitation that the pamphlet was prepared by an attorney for the Steel Corporation; perhaps by one of the younger men, less austere and more imaginative in his style of writing than his seniors. It is a caustic, *ex parte*, frequently inconsistent, condemnation of the report of the Interchurch Commission, and a palpably biased defence of the policy and attitude of the Corporation, with a generous sprinkling of encomium for Judge Gary himself. For example: "The best way is to humanize the finance committee as it has been done with remarkable success in the personality of its chairman, Mr. Gary". Even he might blush at this fragrant compliment. The controversy between the American Federation of Labor and the Steel Corporation has two sides; much can be said in defence of Mr. Gary and his policy with respect to labor; the Corporation is doing a great deal toward the betterment of working conditions among its employees; and it is justified in publishing and distributing literature aimed to apprise the public of these things. Such is the obvious purpose of this pamphlet, which would be in no way remarkable except for what is revealed in the letters of introduction. The arraignment, it appears, is an address delivered before a meeting of Boston ministers at Pilgrim Hall by the Reverend E. Victor Bigelow of South Church at Andover, Massachusetts. In the first letter Mr. Gary expresses appreciation and gratitude that an "entire stranger" should take the trouble to present the "Interchurch world report in its true light" and asks permission to print and circulate the address. In the second letter the Reverend Mr. Bigelow reciprocates the appreciation and accedes with alacrity to the request. Were it not for the unimpeachable character of the reverend gentleman's position we should suspect collusion, of the kind vulgarly known as a 'frame up'. We venture to suggest to Mr. Bigelow that his address would have been far more convincing if he had been able to see some of the arguments on the other side; but the most astonishing thing is that the astute Mr. Gary should be misled into thinking that the camouflage of Mr. Bigelow's clerical habiliments would make the propaganda more effective.

The Position of Silver

Revival of mining in Mexico has been checked temporarily by the drop in the price of foreign silver, despite the stabilizing effect of purchases of American silver under the Pittman Act. The metal is produced most cheaply in the Paahuca district, where the cost is slightly under 60 cents per ounce; in other parts of Mexico the cost of production at the smaller mines is about 80 cents, the general average being about 70 cents per ounce. In the United States the cost ranges between 40 and 80 cents, excluding the by-product silver incidental to exploitation of ores valuable chiefly for the base metals, copper, lead, and zinc. At Cobalt, in Canada, the average cost is about 50 cents, with a low figure of 37 cents for the Nipissing mine. It is obvious that if the market price remains near 60 cents, it will be necessary for many, if not most, of the silver mines outside the United States to cease operations. That, of course, will tend at once to correct the sag in price by increasing the demand, which has fallen off for two principal reasons, of which the chief is the temporary cessation of buying from China. During the War the prosperity of the Chinese caused them to buy silver freely, such buying being further stimulated by the fact that Great Britain and others among the Allies stripped China bare of silver in order to adjust their balances in the Far East. We know how the employment of Indian troops in Mesopotamia and Egypt, and of Chinese in France, called for a large supply of silver coinage. These various abnormal conditions opened a voracious market for silver in the Orient. In Europe likewise the payment of soldiers made a call on silver coins of every kind. Since the Great War the depreciation of paper money has been so great that it has been profitable to melt silver and exchange it at a large premium for paper currency. A final blow at the weakening market was delivered by the French government when recently it decided to sell 40,000,000 ounces of silver at the rate of 400,000 ounces per week, in order to meet pressing financial demands. General conditions, as will be seen, have been extremely unfavorable to the maintenance of what the miner would consider a fair price for his product. The purchases under the Pittman Act have checked the collapse somewhat. Under that Act our Government is buying back from the American miner the 207 million ounces that it released from the Treasury three years ago for the benefit of British finance in the East. Thus far only about 30 million ounces have been purchased by the Government, and it is estimated that it will take at least four years to complete the transactions authorized under the Act, provided that foreign silver sells for less than a dollar per ounce, for if it goes above that price on the open market the American miner will cease to sell his product to his Government, and thus prolong the completion of the purchases legalized under the Pittman Act. Meanwhile the silver being produced in Mexico is being coined rapidly, thereby helping to cure the inflation of the currency caused by 'infalsifiable' paper of various kinds and denominations. The coinage of Mexican silver is proceed-

ing at the rate of 24 million ounces per annum, equivalent to about a third of the normal production. This will be a factor in restoring economic conditions in that country. Our miners are still the beneficiaries of the Pittman Act. Conditions are bad, but they might be much worse. Before they do become worse, it is likely that the decrease of production, in Canada and elsewhere, partly incidental to the curtailment of copper mining, will tend to correct the present unfavorable status of silver.

The Broad Lode Hypothesis

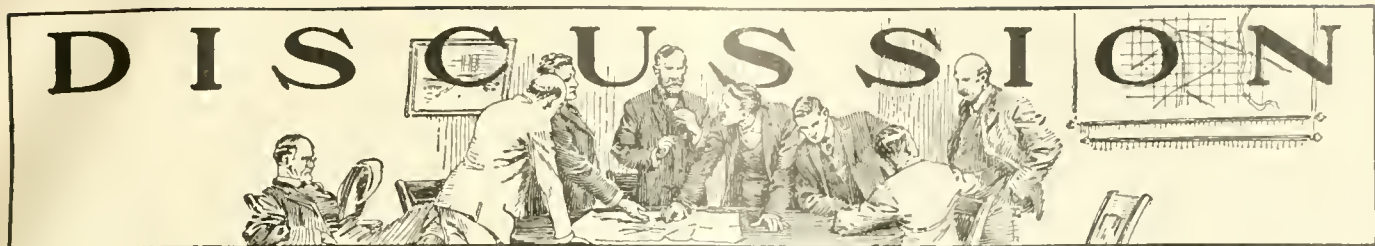
Our contemporary in New York has been discussing the limestone-lode theory as the chief point of contention in the Bingham suit, thereby eliciting a protest from a gentleman prominent in mining litigation. The controversy is an old one, for it may be said to have been the crux of the celebrated Eureka-Richmond suit, which was litigated in 1877. The question arose whether the 'lode' at Eureka, Nevada, was the limestone formation in which ore had been found or whether it was the system of ore-bodies more or less connected by fractures along which ore was distributed irregularly. One side wanted the entire stratum of limestone to be regarded as a 'lode' formed by the enrichment of the rock through fracturing and impregnation with minerals containing lead and silver; the other side insisted that only the connected fractures, with their local enlargements into chambered masses of ore, constituted a 'lode' or 'vein' as recognized by legal statute. At Eureka the limestone lies between quartzite and shale; it varies in thickness from a mere seam to a bed 500 to 800 feet wide, thereby forming a wedge-shaped mass of rock, in which orebodies of irregular shape were discovered. Mr. Justice Field, who delivered the opinion in the case, said that "the limestone zone in Ruby Hill, in Eureka district, lying between the quartzite and the shale, constitutes, within the meaning of the acts of Congress, one lode of rock bearing metal". The phraseology is curious, he did not say 'metal-bearing rock', as he might well have done. His main argument was that "the broken, crushed, and fissured condition of the limestone gave it a specific individual character by which it could be identified and separated from all other limestone in the vicinity. In the zone of limestone numerous caves or chambers were found, further distinguishing it from the neighboring rock". The editor of our contemporary in New York, Mr. J. E. Spurr, is a distinguished geologist with wide experience in the field, and is therefore thoroughly competent to discuss the question in a useful way. He objects to the definition brought forward in the Bingham case, namely, that "a lode or vein is mineralized rock or rocks which contain such indications of valuable minerals as to justify development with the expectation of finding ore. As soon as quartzite over a considerable distance becomes mineralized, then it becomes a lode". We agree with Mr. Spurr that this definition is so inclusive as to be unreasonable, and we would even say that it was ridiculous if it had not been the cause of a long and expensive litigation in the course of which honorable scientific men

have given testimony in support of it as a serious interpretation of geologic structure in terms of industry. At the time of the Eureka suit the structural relations of ore deposits were but little understood; in those days the simple fissure vein, viewed as a tubular body of ore along a steeply inclined fracture in the crust of the earth, was the type upon which the law of the apex was predicated; since then the world-wide expansion of mining has disclosed divagations from this type so marked and so varied as to compel a complete departure from those early and elementary ideas of lode-structure. The classification of ore deposits has become as complex as the forms in which ore has been found in nature. It is true, the word 'lode' means something that leads the miner and in the term 'deep lead' we have its etymology disclosed; so also the word 'vein' suggests the ramification of blood-vessels in the human body. Thus 'vein' is more suggestive of definite form than 'lode', but whichever term be used it must be tied to the economic factor in mining, that is, the winning of ore, which, in turn, entails a recognition of 'ore' as metal-bearing rock that can be exploited at a profit at a given time and place. The loose description invoked at Bingham corresponds with what the Cornishman calls "symptoms of indications"; it bears no relation to the shape or form of an ore deposit—and that, it will be argued, is no defect, for are not some ore deposits without visible boundaries, their limits being dependent upon the valuable metallic contents of the rock as determined by assay, the delimiting quality of which depends upon the current value of the metal being sought and the cost of the operations needed to extract it in marketable form? On the other hand, the idea that the presence of metal in proportion however minute suffices to turn a rock formation into a lode is untenable, for then the ocean is a lode and the peninsula of Lower California is another. The *reductio ad absurdum* is easy, as Mr. Spurr shows in his humorous reference to the geology of Bingham. The clue to the difficulty, of course, is in the recognition of the real meaning of 'ore'. If "the quartzite over a considerable distance becomes mineralized", it does not become a 'lode' unless the mineralization is synonymous with ore; in other words, the mineralization must have been so intense as to result in a concentration of economic value, that is, one yielding a profit to the miner. Besides this economic factor, of exploitability, there is implicit in the words 'lode' and 'vein' the old idea of structure. The enriched rock has boundaries; even if they have to be determined by assay, they will be found to be tied in some way to structural lines or planes, to walls, to fractures, to shear-zones, to something identifiable with the mode of origin of the ore deposit. At Bingham, for example, even the geologic sections submitted by the advocates of a limestone lode indicate some genetic connection between the impregnations of ore and the faults, fissures, and dikes that traverse the terrain. The Court held that the limestone was not continuously mineralized, that the part intervening between groups of mine workings was "unmineralized and barren", emphasis being

placed on the fact that this part of the formation had not been prospected. Here comes the suggestion for a distinction between the geologist's idea of what constitutes mineable ground as against the miner's idea of ground that he ought to prospect; the miner's object is to make money, the geologist's is to obtain scientific information. If the geologist had to spend his own money and apply his own muscle, he would, we think, restrict his definition of 'lode', from whole rock formations containing traces of metal to those recognizable channels and delimitable zones along which the agencies of mineralization have so concentrated their physical forces and chemical reactions as to produce enrichments sufficiently valuable to incite the miner's toil, not merely excite the geologist's curiosity.

Mr. Bain's Appointment

On the last day of 1920 it was announced from Washington that Mr. F. G. Cottrell had resigned as Director of the U. S. Bureau of Mines and that his successor would be Mr. H. Foster Bain. Dr. Cottrell's public spirit is so well known as almost to be proverbial; his scientific discernment is likewise recognized cordially by his fellow-workers. He was Assistant Director of the Bureau when last year he succeeded Mr. Van H. Manning as Director and previously he had been chief metallurgist to the Bureau. Mr. Manning, it will be recalled, was assistant to the late Joseph A. Holmes, who was the first Director, taking charge at the time, in 1910, when the Bureau was created by enactment of Congress. Dr. Cottrell has been chairman of a division of the National Research Council, this being the kind of work most congenial to him. He will return to it now. The responsibilities that he has carried most capably for the past year are transferred to Mr. Bain. As to Mr. Bain, he needs no introduction to our readers. He was editor of the 'Mining and Scientific Press' from 1909 to 1915, and then for a short time he was editor of 'The Mining Magazine' in London before going to China in 1916. From there he was called in 1917 to become assistant to Mr. Manning, so he is already familiar with the work that he will now direct as chief. In 1918 he resigned to return to China, where he was engaged in the examination of mines for an important Anglo-American syndicate. He returned to this country in November. By that time he had been invited to succeed Dr. Cottrell and after some hesitancy he accepted the appointment, being urged to do so by many of his friends. He is 48 years of age, a native of Indiana, a Ph.D. of Chicago University and a post-graduate student of Johns Hopkins. He has practised as a mining engineer in several States and has traveled in many countries; for four years he served as State Geologist of Illinois. He has lectured on economic geology at several universities. This outline of his career indicates an ideal preparation for the important task to which he has now put his hand. By temperament, experience, and personal qualities he is peculiarly fitted to be an officer of the Federal government. We wish him the success that we feel sure he will deserve.



Silver as Money

The Editor:

Sir—I am just in receipt of your issue of this date in which Mr. Blamey Stevens has for discussion an article entitled 'An International Association of Silver Producers'. Having been very much interested in silver for the past ten years I have had occasion to make some study of the metal and its "peculiar position" among metals. Just in the last issue of the 'Engineering and Mining Journal', Mr. Spurr publishes an article by myself under the title of 'An Advocate of Bimetallism', which was more of an argument against the Gold Bonus Bill now under consideration by Congress.

Now, if you will be kind enough to allow me the space in your worthy journal, I would like to answer Mr. Stevens with this letter, under the title of 'Silver as Money'.

In July, Mr. Charles Butters came through Nogales and delivered an address on silver, with the same object in view as Mr. Stevens. Today he is back in Nogales after an extended trip in the East, where he informs me that he got the "cold shoulder" on such an idea everywhere he went. He seems to have become discouraged, and has closed down some of his silver mines. Now Mr. Butters, in my opinion, made the subject look like too much of a personal matter, but, on the other hand, always emphasized the fact that silver was necessary as money.

I am surprised that any man should attempt to organize an association to sell a certain commodity to a government and start out, like Mr. Stevens, by saying that it was "no longer suitable" for the purpose for which said governments would use it. It will be my object herewith to state facts pertaining to the issue from which any reader can arrive at his own conclusions.

In his recent address before the Federated American Engineering Societies, Mr. Herbert Hoover, its president, among many good things, said: "This engineering association stands somewhat apart among these economic groups in that it has no special economic interest for its members. Its only interest, in the creation of a great national association, is *public service*. . . And if engineers, with their training in quantitative thought, with their intimate experience in industrial life, can be of service in bringing about co-operation between these great economic groups of special interests, they will have performed an extraordinary service".

I believe the proper way to approach the subject of silver as money is first to go to the fundamental principles

upon which its value depends. So, first let us look up a bit of history on the subject. Shekels, or pieces of silver, are referred to in the Book of Genesis. Abraham, in the land of Canaan, bought a field for sepulture and paid for it in silver. Silver as well as gold was employed in the erection of Solomon's temple at Jerusalem. In 1000 B.C. the ratio of silver to gold was 12:1. At the Christian era it was 9:1. At 500 A.D., just 24 years after the downfall of the western Empire of Rome, the ratio was 18:1, but in 1100 A.D. it had fallen to 8:1. At the close of the seventeenth century it was 10:1, and at the end of the last century it was 15:1. In 1850 the ratio was 15.4:1. In 1873 it was 16:1. In 1896 it was 30:1. In 1902 it was 39.15:1. In 1913 it was 34.19:1. During the War, and just after, it varied from almost 50:1 to 15:1.

I presume it is owing to these last few years of extraordinary fluctuations that Mr. Stevens draws his conclusions that silver is no longer "suitable for money". I agree with him that such wide differences are uncalled for, even in the worst of times, and that something should be done for silver. However, we must not lose sight of the fact that such regulations as favor a minority interest in this line or any other line will neither be popular nor stand the test of time.

This is an international subject, I well appreciate, and it must be handled as such. But I feel sure I am absolutely correct in saying that anything done to control the price of silver and thus eliminate speculation must from the nature of the case come from the other side, that is, the consumers and governments in this case.

In this age of civilization we all constitute the government of our individual nations and we must be made to see the absolute need of the things that our tax-money is to buy; and, furthermore, the great struggle through which the world has just passed certainly has shown the absolute need for co-operation among nations and the need of an international congress, which unquestionably will soon be adjusted or formed with all nations participating.

Hence all that is wanting in the case of silver is to prove that it is necessary to the united governments, then the correct price and demand will take care of itself. And this proof I hope to give in the following paragraphs.

Money is merely a medium of exchange. And although there are a few who do not even think that we need a medium of exchange, I believe it will stand without further argument that to carry on trade and commerce some medium of exchange is absolutely essential. Now, does this medium of exchange have to have an intrinsic

value? That is the question before the world today. If it does not, why produce gold? Why mine more silver? I say, cut them both out and continue to issue paper (as it is about the cheapest thing we can find). Some say, use a bushel of wheat for a dollar; all right, everybody will do nothing but plant wheat, while others will charge more than it is worth for transporting it. Name anything else that would be suitable for money, analyze it, ask if it can be counterfeited, preserved, etc., and see to what it leads.

Silver and gold possess the physical and chemical characteristics necessary for a permanent international medium of exchange. Gold today is at a premium in Europe. Why? Because it is scarce, and therefore has value. Some American mining men and bankers are advocating a \$10 per ounce bonus on American gold. This law should not pass, because it favors the few gold miners, and will tend to disturb the only standard we have. The gold miners are now being favored by the decrease in the cost of production. The American silver miner sold, through his Government, under the Pittman Act, practically four years' production in advance for the just price of \$1 per ounce. France as a last resort melted up her silver coins and dumped them on the market further to decrease the price of silver. England, we read, for the first time in history has been able to pass paper money in India, and still she produces 75% of the world's gold, with which she expects to pay off her international debts. Now, with all of these basic facts before us, how can we argue that a medium of exchange does not have to be backed up with something of intrinsic value? However, for argument's sake let us assume the contrary.

In modern times what has been this medium of exchange? Letters of credit, bills of exchange, paper money, bonds, notes, checks, and drafts, etc., all of which are good, convenient, necessary, and desirable by business men. I do not argue for a system that would abolish these, but I do say the world of nations does need something to fall back on in case of war, and this, as argument and history show, must be gold and silver. I say, encourage all the gold and silver production possible, encourage its use in the arts, as small money, in jewelry, ornaments, table-ware, moving-picture films, photography, and every other use possible. The production of gold and silver, I think, can never exceed the demand, if they are fixed in price at some definite ratio—weight for weight—of pure metal. By so doing, in case of an emergency, when foreign exchange on paper falls in value, there would be some stocks of so-called luxuries to fall back on and put into use as money. The best example of such action was shown by Germany during the War in the case of copper, the melting up of church-bells and copper utensils of all sorts. I further believe that if the world had been on a better and sounder financial system prices during the War would never have risen to such a high level, and in turn the different nations would not have been allowed to extend such unlimited credit, the results of which we now face in a period of depression. Why?

Foremost because Europe has not the money with which to buy our products, that is, she has a money, but we say the exchange is from 5 to 75% of what they value it in trading among themselves. Can it be expected, for example, in the case of France, whose franc is quoted at about six cents, to buy our copper even at 14c, and pay the exchange, which would be about the same as paying us over 50c. per pound for copper. It is not quite that bad with some other nations and even worse with others at the present time. This example applies to practically every commodity that we produce. It seems to be the direct result of the system of trading on an indefinite credit basis. Now if foreign exchange is going to paralyze business, and cause hunger and suffering the world over, as well as undue fluctuations in all commodity prices both up and down, it certainly seems to prove that it is essential that the medium of exchange shall have an intrinsic value, either directly or indirectly.

We learn that our warehouses are full of food, wool, cotton, and other raw materials. Our wheat districts have no place to store more flour. Our mines are having to curtail production. There is no market for our products. On the other hand, we are asked to feed starving nations in Asia, and in China people are starving by the millions. Ample supply on this side and a pressing demand on the other. Why do not the laws of supply and demand function? Many thought the political elections were the cause, others still think that after the change is effected at Washington, things will be better; however, they will find that other things, more important, are responsible for present conditions. The fault is simple and may be expressed in a few words: an unstable medium of exchange. The making of a commodity out of silver, and even gold. All of which should be stable and used as definite measures only.

Now, what is the remedy? Either, further unlimited credits, or else call a special International Monetary Conference, sending authorized representatives from all nations, and first adopt a definite ratio between gold and silver with a definite proportion of credit expansion that would govern all nations alike, so that the different nations would ultimately adjust their coinage to that ratio, and the gold and silver money would become eventually international currency. To avoid the expense of transportation, the nations should issue gold and silver certificates indicating on them the actual weight of pure metals deposited in their own vaults. Thereby a lot of silver would be brought back into monetary use that is being held as a luxury now in the European countries, and in that way the more wealthy nations could extend further credit to such needy nations as their credit expansion warranted, and business would commence immediately. As silver and gold become more plentiful the national debts of the different nations could be paid or decreased, and the ratio of credit expansion, with gold and silver stocks as a basis, might be all that would have to be altered in future generations. Of course, the details of ratio, seigniorage, credits, etc., would have to be worked out from statistics, but they present a minor de-

tail. All of which could be done in half the time that Congress might spend in debating the McFadden Bill.

I believe it is time that we Americans quit wasting time on dreams and get down to business. Unlimited credit means waste, extravagance, speculation, and sorrow. Cash, with limited credits and conservatism mean prosperity, economy, and happiness. We producers of metals and agricultural products must realize that war prices were a nightmare. On the other hand, consumers must realize that progress means better living conditions, higher esthetic wants of individuals, consequently higher wages and production costs.

HUGO W. MILLER.

Nogales, Arizona, December 18, 1920.

Power From Low-Grade Fuels

The Editor:

Sir—Referring to my two previous letters on this subject, I find in Bulletin 55 (1913) of the U. S. Bureau of Mines, by R. H. Fernald, that in that year there were from 900 to 1000 plants in the United States generating a total of 200,000 hp. from producer-gas. Of a list of 722 plants, 610 were using anthracite, 77 bituminous coal, 32 lignite, 1 wood, and 2 oil. A map accompanying this publication showed that most of these plants are in a region covering the north-central and north-eastern States. In the South and West, the installations could be counted on two hands, showing that where oil is produced and plentiful, it is either burned under boilers or the distillates are used in stationary engines. The advent of the oil-engine, its general simplicity, and an abundance of oil stopped development of the gas-producer; but as liquid fuel becomes scarcer and higher in price, the use of producer-gas may be extended. I understand, on good authority, that the net result of gas-producer installations in America has been to make a demand for special fuels, which work easily in gas-producers, so as to reduce the labor charge; in fine, they failed to utilize low-grade fuel or waste-products. How different is this result to that of British and European practice, where many times the American total of producer-gas plants are in successful operation. It might be helpful if engineers and others interested secured copies of the following Bulletins of the Bureau of Mines, which cover producer-gas power both here and abroad: No. 4, 7, 9, 13, 31, 55, and 109; also Technical Papers No. 9, 20, 123, and 207.

M. W. VON BERNEWITZ.

New York, December 10, 1920.

Prospecting

The Editor:

Sir—I read with interest an advertisement in your last issue, advising young graduates to go prospecting, and it brought to my mind certain questions.

First, like most young technical men from the East, I have had little opportunity to come into contact with the old-time prospector and I thoroughly realize that it is no game for a tenderfoot to play on a lone hand. Therefore,

I would like to know how to get in touch with some old-timer.

Second, what districts are there left to prospect, at the present time, other than Mexico?

Third, how much capital is needed, and what are the chances of getting grub-staked?

Perhaps some of your readers can enlighten me on these questions.

R. S. EVERIT.

Ray, Arizona, November 19, 1920.

Economic Interests

The Editor:

Sir—I am constrained to enlarge upon the opportunities which would present themselves to men charged with the many tasks incidental to rehabilitation and protection (a poor word, but mine own), opportunities that only business men would seize and that engineers would probably ignore.

There is a mill-foreman in a Central American republic who is dissatisfied with his salary. A few months ago he wrote to the New York Steel Exchange, which exports mining machinery, asking if there was any way in which he could add to his income. His letter reached the proper desk in the routine way, and the reply was designed to bring out a statement of the foreman's opportunities. It turned out that besides his immediate employers, there were other mining and industrial companies in his neighborhood, as well as a projected short railway and a village hydro-lighting plant. The foreman's general knowledge in the way of requirements of supplies, iron, corrugated iron, waste, balls, bolts, drill-steel, and the like, made it easy for him to help his neighbors prepare their formal orders, but his ignorance of selling, market prices, exporting, and credit matters is simply appalling. He is a good engineer, but any ten-year-old bank messenger knows more of financial matters.

The export house is always glad to take the trouble necessary to complete the transactions, and this mining engineer is an apt pupil. A long letter from him recently expresses wonder how he could formerly go through a mill, seeing the needs of chrome spare parts, Dorr machines, ball-mills, red-edge shovels, and similar items, and calmly ignore the opportunity to make money. He says he needs the money, too. Seems to have a wife and some children. It is clear from his letters that he formerly looked over a mine and mill from a nose-to-the-grindstone point of view. Now he is a much more useful member of society.

Of course you, Mr. Editor, realize that advance information leading to business is worth money to manufacturers and exporters and to the buyers themselves, and buying advice is worth money to our foreman's neighbors. At first he got business after hours, but soon discovered that he was losing money working for wages. Upon one occasion his enthusiastic faith in the credit of one buyer, whom the exporter would not trust, cost him \$280 on an order he personally guaranteed; but it was cheap experience.

Not a day need pass in the life of a mining engineer

abroad without his writing to New York of an opportunity to do business. Hamilton (you do not know which Hamilton I mean) would have been a millionaire by this time, had he known and remembered this, or had he married and had his wife been told of the opportunities he was missing. Patterson (the above parentheses applies to Pat also) has simply been too lazy to pick up this money. I know of only about 20 engineers who draw drafts like these on New York.

One engineer who lives in Bolivia is about the laziest (commercially) that I know, but I met his wife. She heard me scolding her husband one day about missing his opportunities. He accompanied me to a near-by property and watched the writing of a simple spare part and supply order. When we returned to his house, I showed him *and his wife* what would be charged to the order for overhead and traveling expenses, and explained *to his wife* that if he did this work, no doubt any manufacturer would send him an agent's pay-check. Well! He sends up orders, but he is my most deadly enemy. His wife leaves him not a moment's peace. Every *dia de fiesta* they visit some plant, and instead of comfortably enjoying a discussion of jigs and tables and tailings, he is allowed only half his time for this, and must spend the remainder with the buyer, the *mayordomo* and the *pulpero*. His wife has no ethical ideas so far as concerns the kind of material to be ordered, and considers groceries or *tocuyo* as ethical as ball-mills—and much more profitable. Moving-picture machines and a complete hospital equipment are some of his items, and represent as well as anything his "economic interest" in Bolivia, which Hoover says the engineer does not have.

This engineer (and his wife) have been at this for a year. He is a far better employee for his own company and now knows how to buy. Engineers do not. He makes more in his odd moments than he earns as salary and is independent of salary and job. As time passes, he is less trouble to the exporter and manufacturer because he sends his orders complete; he attends to collections; he makes it easy for the buyer, the seller, and the shipper. His wife writes most of the orders and endorses *all* of the agent's pay-checks.

No one in any industry, or profession, without exception, has the opportunities within the reach of the mining engineer. A near-by prospect is attractive. He can offer it to his employers. If they are not interested, he can offer it to New York. There is no limit, of course, to the number of mines that New York is willing to buy. A man with ear-rings sold a mine here recently for more gold than there is in all Germany and Austria. A live engineer cannot only send advance information on improvements and new works in mining, to exporters and manufacturers who are glad to pay for new business, but he can tell J. G. White & Co. of proposed port works and railways, Pelton of hydraulic developments, Redwood of pipe-line projects, and so on *ad infinitum*. The pages of the journals will give him a name for every different line. He will be careful in his choice of correspondents for each important item, and then will help to close the busi-

ness. No one will pay for words. The engineer is in an ideal position to guide purchases because his opinion commands and merits respect and confidence. He is head and shoulders above the ordinary salesman in the opinion of the machinery buyer, the machinery seller, the works contractor, the buyer of mines, and the exploration company.

Few engineers but could widen their field of activity, broaden their experience, and thicken their bank account by seeing what should be done for and by their neighbors and telling somebody about it. These activities are only recommended to engineers who have thought of ways of using more money than their present income. It would be energy wasted for engineers who are paid a salary which supplies all their needs.

I wish this message could reach the wives of engineers abroad, and I dare each of you to read it aloud to your wife, explaining it to her patiently and carefully and showing how it applies to your particular case. The rest I leave to her, if she has any use for an additional thousand or two a year, and if it does not result in Mr. Hoover changing his opinion of the "economic interest" of mining engineers, I do not know the species 'wife of a mining engineer'.

AMIGO.

San Francisco, December 17, 1920.

Bunker Hill Smelter

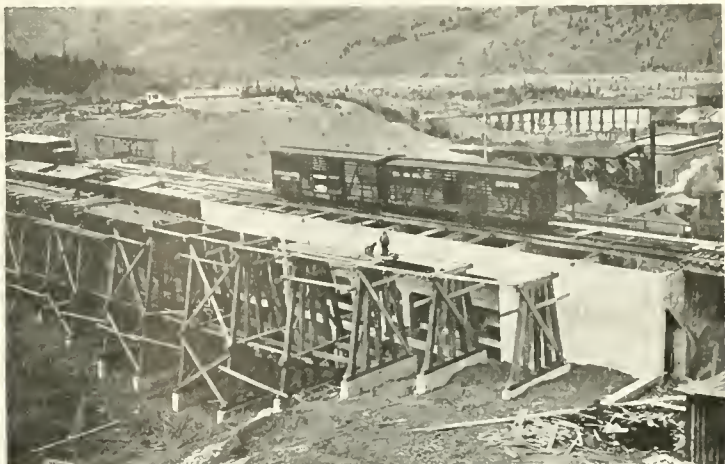
Sundry corrections in the text of the article on the Bunker Hill smelter, beginning on the next page, were overlooked owing to the early date of going to press this week. On page 53, line 7, the assay of the Caledonia ore should show 0.6% copper; in line 26, "the second tuyere jackets" should be "the second-tier jackets"; in the first line of page 54, the revolutions should be 4700; in line 35 of the same page, the height of the charge column should be 11 feet; in line 7 of page 58, "two pounds" should replace "three ounces".

Most of the high-grade manganese ores in the Batesville district of Arkansas contain 45 to 52% of manganese, though some of the ore that has been shipped contained as much as 60.80% in carload lots. They generally contain from 3 to 8% of iron, 0.15 to 0.30% of phosphorus, and 2 to 8% of silica. Some of the ore that has been marketed contained more than 0.30% of phosphorus, and a very little contained 0.50% or more. As the usual requirements of ores that are used for metallurgical purposes specify that their phosphorus content should not be in excess of 0.25%, it is evident that some of the ores are too high in phosphorus. Phosphorus is, in fact, the most harmful ingredient in the ore of the district, but as it is not uniformly disseminated through the ore it can generally be avoided in mining. At some places the silica content is high, exceeding 8%, which is the maximum amount that is usually accepted by buyers without imposing penalties, but at some such places the silica content can be materially reduced by properly treating the ore.

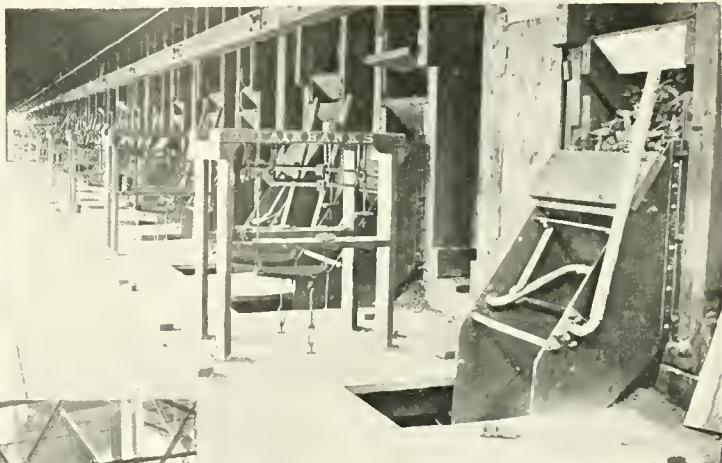
The BUNKER HILL
SMELTER



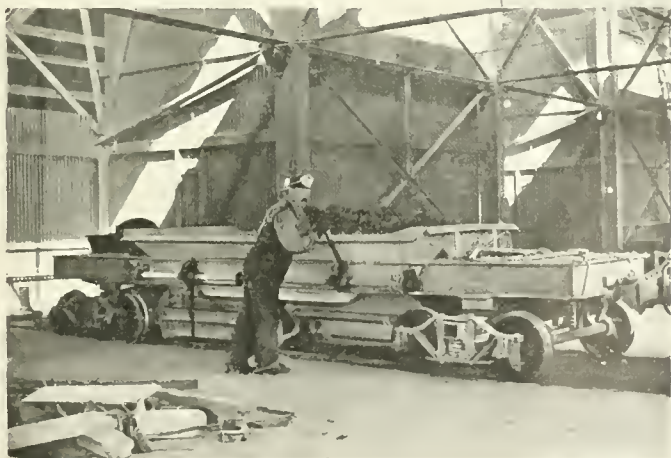
Charge-hoppers



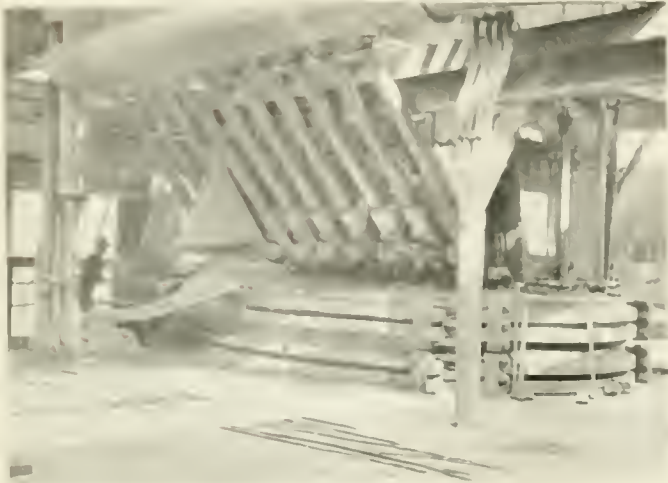
Charge-bins during construction



Scales and charging-chutes



Charge-car



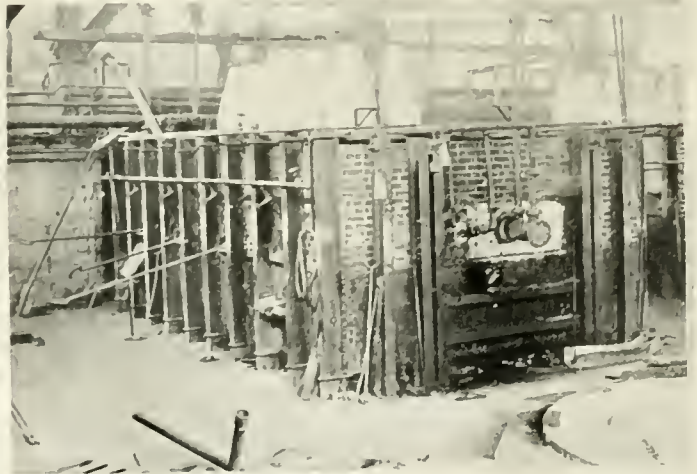
A blast-furnace



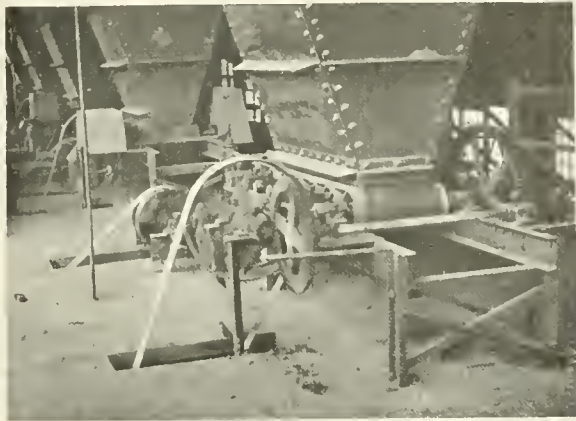
Dumping slag



Lead kettle about to be emptied



Softening-furnace



Feeders to Dwight-Lloyd machines



The Dwight-Lloyd roasters



General view of same



A D-L. grate or palette



Palettes discharging



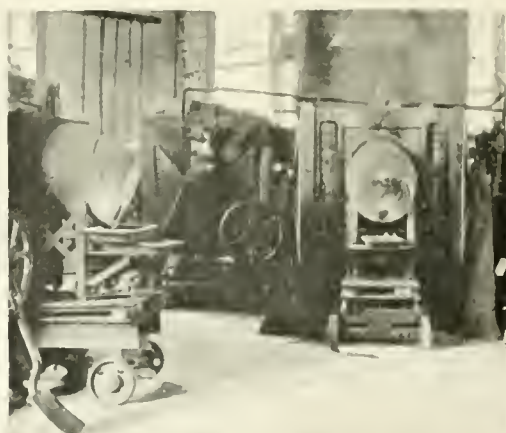
Zinking-kettles; refining-furnace in background



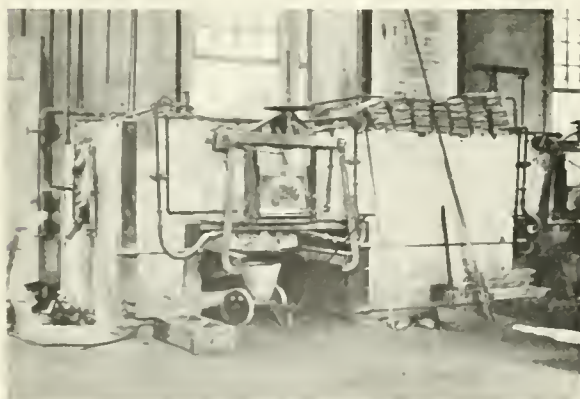
Drossing-kettles, blast-furnace in background



Lead-pump, zinking-kettles, drossing-kettles



Faber du Faur furnace for distilling zinc



Cupelling-furnace in silver refinery



Zinc-retorts and zinking-kettles

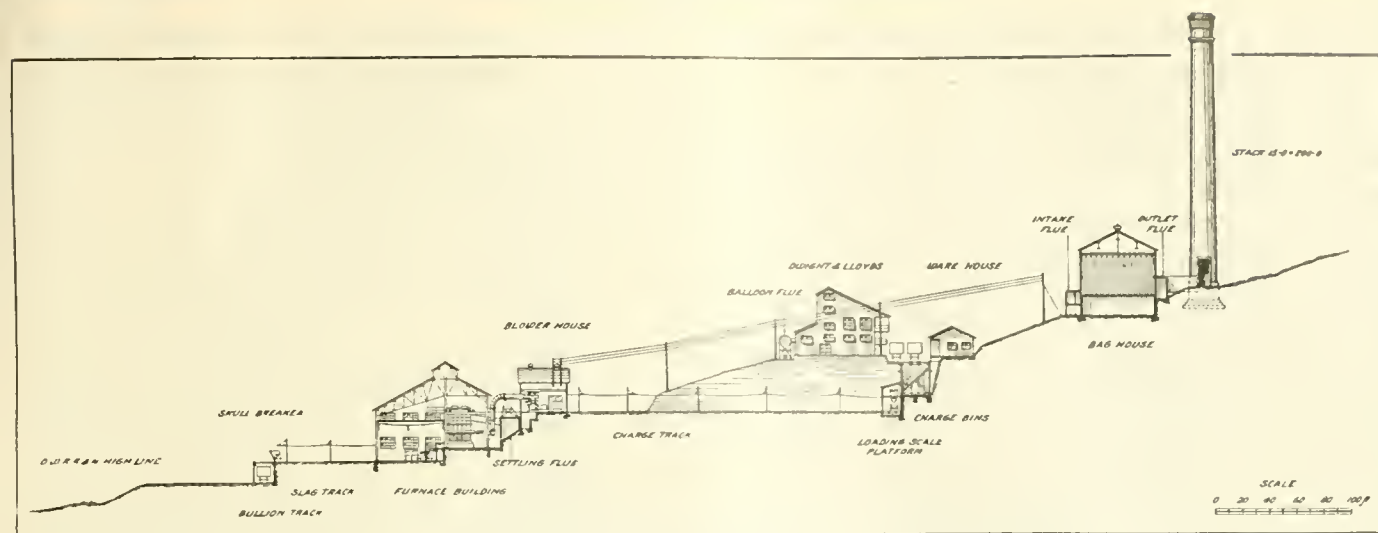


FIG. 1. CROSS-SECTION OF THE BUNKER HILL SMELTER

The Bunker Hill Smelter

By T. A. Rickard

THE SITE of the smelter is the old Bingham ranch, a tract of 80 acres adjoining the Bunker Hill mill-site on the west. It is particularly well suited to the purpose, having a draw or gully on each side of the central hummock; in the eastern hollow are the receiving-bins, the crushing-plant, and sampling-mill; in the west hollow are placed the charge-bins; on top of the ridge between these two depressions are the roasters, track-seales, warehouse, shops, bag-house, Cottrell treater, and stack. Below them are the furnace-buildings, and the refineries. The main level of the smelter has an elevation of 2400 ft. and is connected with the Bunker Hill mill-yard by a standard-gauge railroad, which is a little less than a mile long. There is also a connection on the west with the Sierra Nevada branch line of the Oregon, Washington Railroad & Navigation Company.

GENERAL ARRANGEMENT. From the top of the first ridge west of Government gulch, that is, on the side farthest from Kellogg, one obtains an excellent view of the entire plant. On the extreme right, on top of the opposite ridge, is a 125,000-gal. storage-tank for fuel-oil and behind it are the tanks that store water for the furnaces and for domestic supply. Next below comes the Cottrell treater, a tall narrow structure, and to the left of it is the stack, made of radial brick, 200 ft. high and 15 ft. in diameter inside. Against it appears the bag-house, which is built of brick and contains three compartments, each of them holding 400 woolen bags, through which the fume filters. A little in front and west of the bag-house is the fan-house, which contains two No. 19 Niagara conoidal 160,000-cu. ft. fans, for pushing the furnace gases through the bag-house and up the stack. The same building contains electrical equipment for the Cottrell treater. Athwart these buildings is seen the main flue ascending the hill. From where the flue passes

under the main railroad tracks to the Cottrell treater it is divided into two parts. The upper part is used for the roaster gases, and the lower part for the blast-furnace gases, and also for a direct connection to the stack. In the gulch immediately below the spectator are the charge-bins and railroad tracks. On the sky-line, and below the bag-house, is the assay-office belonging to the Hecla, where a representative of that company is domiciled. To the left, below this assay-office, is the roaster-building. In front of it is a steel balloon-flue leading to a chamber that serves for humidifying the gases before they enter the main brick flue. Below the roaster-building is a small change-house for the employees; then comes the charge-track leading to the blast-furnaces; the first building below this track is the power-house, which contains the blowers, compressors, and motor-generator sets, and also the switchboards that control the distribution of power to the different parts of the smelter and refinery. Next is the furnace-building, and in front, just below, is the lead refinery, athwart which appears the silver refinery. On the extreme left is a building containing the Bonnot coal-pulverizing plant. At the rear of the roaster-building one can get a glimpse of the top of the crushing and sampling buildings in the gulch beyond. To the right of the silver refinery there is a 100,000-gal. tank that is used for cooling the jacket-water from the blast-furnaces, refining-furnaces, lead-casting wheel, etc., and in the gulch at the spectator's feet is the building in which copper sulphate is made. The system of railroad tracks includes the high line, on which come the ore, coke, and flux. Below the lead refinery is another track for the removal of the product. The silver bullion is shipped by express on a passenger train, at the station named Bradley, after the president of the company. The main office, assay-office, warehouse, and machine-shop are not visible from

our point of vantage, being hidden by the other buildings. A reference to the plan and section (Fig. 1 and 2) will make the description clear.

After preliminary surveys, the construction of the plant was started on May 1, 1916, and the first blast-furnace was blown in on July 5, 1917. The plant cost \$2,500,000. The accompanying photographs show three successive stages of the construction. The plant was designed by Jules Labarthe, of the firm of Bradley, Bruff & Labarthe, of San Francisco.* It consists essentially of the crushing and sampling mill, Dwight & Lloyd sintering machines, Traylor blast-furnaces, lead refinery, silver refinery, besides bag-house, Cottrell treater, power-station, and the necessary equipment for receiving and storing the various materials that go into the furnaces.

THE SAMPLING-MILL consists of two parts, for coarse and fine crushing respectively. The former has three receiving bins, and the latter four. These bins are built of wood, and each has a capacity of 3500 cu. ft. Material of large size goes through the coarse-crushing plant, which contains an 18 by 30-in. Allis-Chalmers jaw-crusher. This building has the necessary elevators and screens, so that in crushing limestone the oversize material, about $2\frac{1}{2}$ in., is delivered back into a railroad car and can be taken directly to the blast-furnace charge-bins and stock-pile, while the undersize can be delivered directly to one of the roaster-charge bins. If it be necessary to crush the material fine, it can be passed to the fine-crushing plant, which has the following equipment: one 48-in. Symons disc-crusher, two 16 by 42-in. Allis-Chalmers rolls, and a Mitchell vibrating screen, with the necessary elevators and belt-conveyors. There is a 30-in. belt-conveyor in front of the three bins of the coarse-crushing plant; this conveyor feeds directly into the jaw-crusher. A similar conveyor serves the four bins of the fine-crushing plant, and feeds directly into the Symons disc machine. At the discharge end of the fine-ore belt-conveyor, and directly above the receiving-hopper of the Symons machine, is placed a 220-volt magnet, made by the Electric Controller & Manufacturing Co. This magnet, Fig. 3, removes steel, scrap-iron, nails, etc., that may have accompanied the ore into the Symons machine. Such pieces of scrap might otherwise get into the disc and cause an expensive shut-down. There is very little trouble with the Symons disc-crusher, because the feeding-belt is also used as a picking-belt and when lead matte is being crushed any pieces of lead that may be in the matte can be easily seen and picked out, the matte having been already through the coarse-crushing plant. I noticed a collection of material that was caught by the magnet: it consisted of tobacco-cans, snuff-boxes, railroad spikes, bolts, fish-plates, nails, hammer-heads, and pieces of drill-steel. The 'bit' of a miner's drill is non-magnetic, and such material has to be picked by hand off the

feeding belt. An ingenious feeder is used at this point. This is set directly under the bin and over the belt. The gate of the bin is opened wide and the feeder is controlled by means of an electric switch, by which the operator can regulate his feed to suit the Symons disc. On the Mitchell screen, it is customary to use Ludlow-Saylor's wire-screen No. 523, and also No. 581. There are three Vezin sampling-machines, which take the entire stream of crushed ore during part of the time, and there is also a small set of Chalmers & Williams rolls, 12 by 12 in., immediately above the last sampler. The cut from this last sampler is caught in a small cart that is pushed by hand into a room where the sample is cut down on a floor covered with steel plates. One sample is taken to the assay-office, while the reject is put in a sack and kept in reserve in case re-sampling should be required. The ore is taken from the mill by a 20-in. belt-conveyor dis-

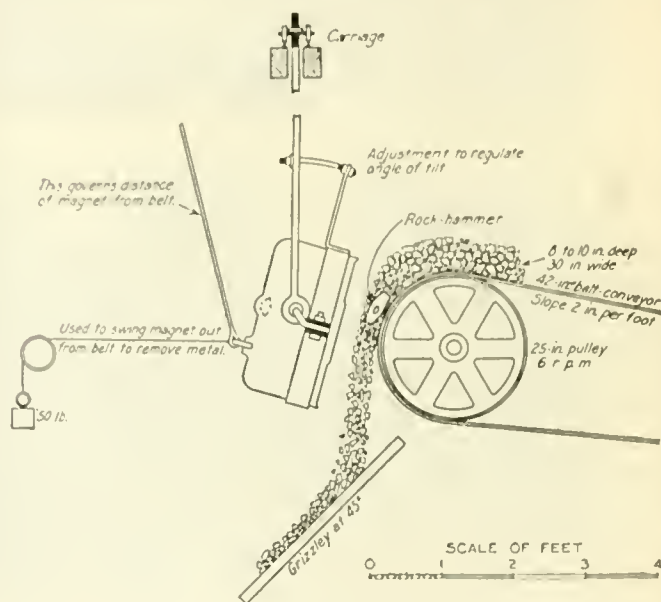


FIG. 3

charging by means of a tripper into one of the series of eight roaster-charge bins. At the end of this belt-conveyor there is also an inclined belt-conveyor of the same size, so that if it becomes necessary to store the material, or take it to the furnace-charge bins, it can be fed directly into railroad cars. There is another row of bins immediately south of those just mentioned. The tripper cannot reach these bins, so that when it is necessary to fill them with ore from the sampling-mill, it is simply transferred in railroad cars. However, this second row of bins is generally used for material that can be hand-sampled directly out of railroad cars. There are three lines of track over this system of bins and they are so arranged that a car can be spotted on the central track and unloaded into bins on either side.

THE ROASTING-PLANT consists of nine Dwight & Lloyd sintering machines and one Wedge furnace. This last has seven hearths, each of 23-ft. diam.; but it is not in use at present. The Wedge furnace was used for roasting the lead matte, but for over a year the matte has been double-roasted on the D. & L. machines. At the present time the

*Mr. Easton, the manager, tells me that particular credit is due to Walter K. Mallette in directing the construction of the smelter. Thanks to his energy and good judgment it was possible to complete the erection of the plant, without delay or confusion and at a minimum of expense, within a little more than one year.

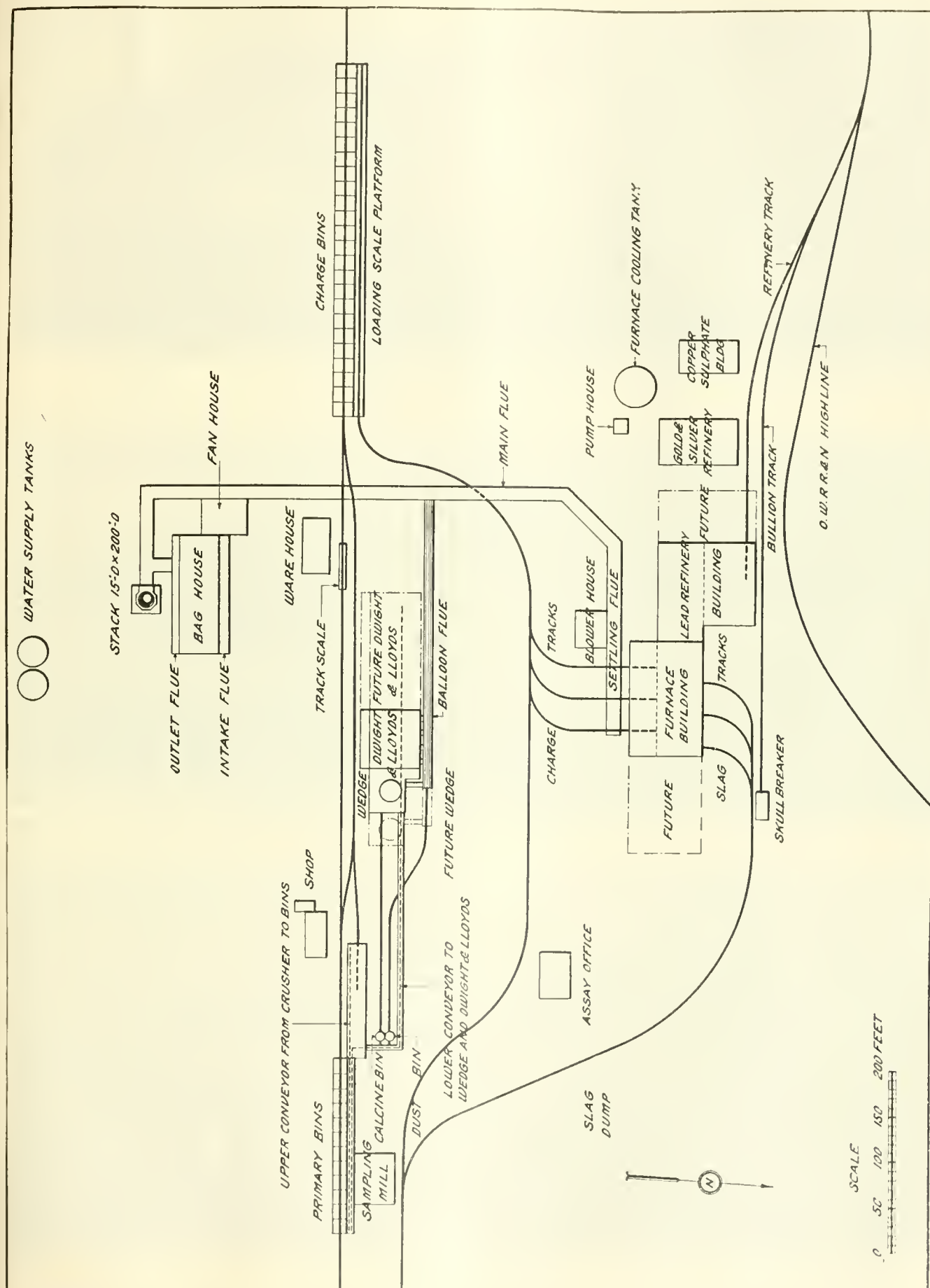


FIG. 2. PLAN OF THE BUNKER HILL SMELTER

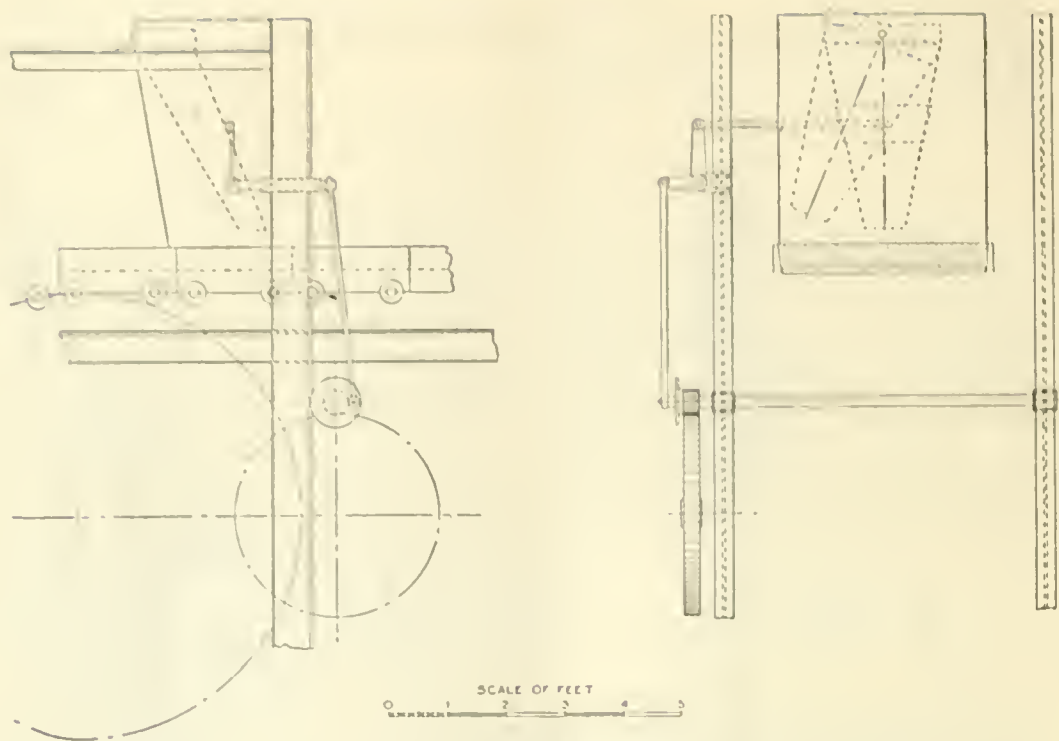


FIG. 4

smelter is receiving no material that has a sulphur content high enough to need preliminary roasting in the Wedge before treatment in the sintering machines. The charge is brought from the different bins by a series of 20-in. belt-conveyors to the receiving-hoppers of the D. & L. machines. At the top of the building there is a tripper that can be set over the hopper of any machine. The charge is fed from the storage-hopper of each roaster by a belt-conveyor into a blind-trommel mixer and it is then delivered onto the D. & L. grates by a swinging-spout feeder, as shown in Fig. 4.

The grates used on the D. & L. machines were designed at Trail, by R. H. Stewart, formerly general manager for

the Consolidated Mining & Smelting Company of Canada. His 'pallet', one unit of a jointed moving hearth, has five interlocking serrated grates; so that the interior grates are fixed and loose alternately, causing the sintered ore to detach itself readily when about to be dumped. A new method of fastening the grates to the pallet has been devised by A. L. Larson, mechanical superintendent in this smelter, and a sketch of it was given to me by M. H. Sullivan (McGill '04), the superintendent* of the smelter. See Fig. 5. There are only three bolts holding the fish-plates to the sides of the pallet where in the original grate there were seven bolts. This new method of attachment simplifies the replacement of a broken grate. Each grate has three loose members, and on account of their differential movements it is kept clean. Sidney Butler, the general foreman of the roasters and blast-furnaces, has devised a method for leveling the movable members of the grates. This device as developed here consists of a heavy cast-iron wheel—a discarded crane-wheel is suitable—mounted on a

*To whom I am indebted for invaluable assistance in the preparation of this article.

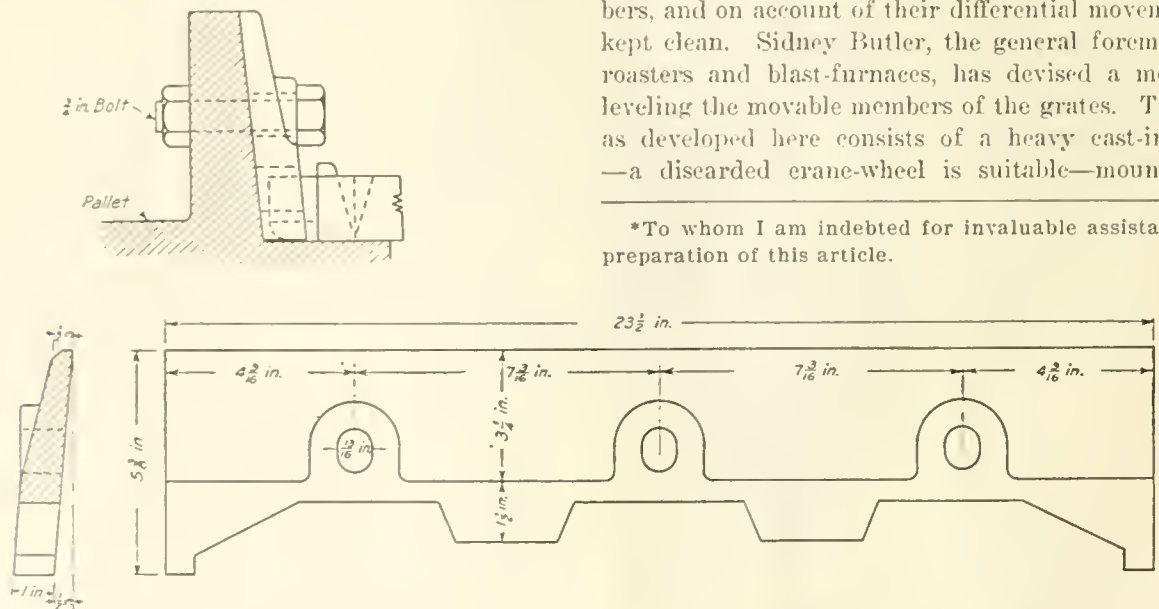
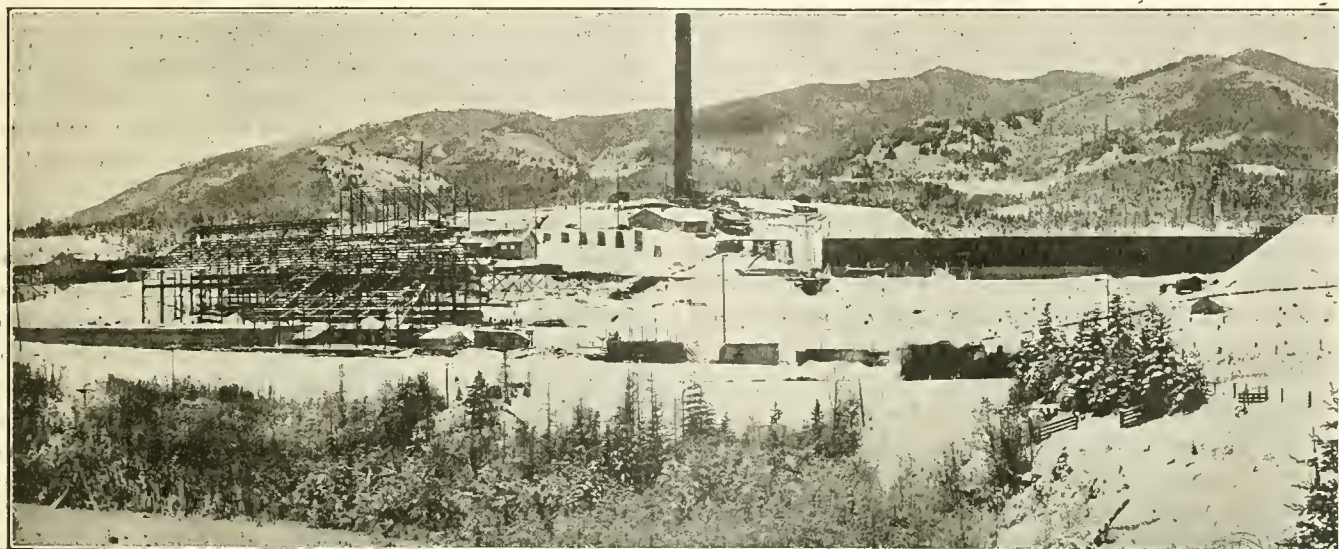


FIG. 5. DEVICE FOR CONNECTING THE GRATE TO THE PALLET OF THE DWIGHT & LLOYD SINTERING MACHINE



ON AUGUST 20, 1916



ON DECEMBER 13, 1916



ON OCTOBER 3, 1917

THE BUILDING OF THE SMELTER

shaft that is held in place by two pieces of angle-iron bolted to the frame of the machine. Each angle-iron is attached by a single bolt. This allows the wheel to move up and down, and when the pallet passes under the wheel, the movable members are leveled to the plane of the fixed members. If the grates are not leveled, there is a tendency for the sinter to stick to the projections of the tilted members at the discharge end of the roaster.

At the present time pulverized coal is being used for the ignition of the sulphur in the ore to be sintered, whereas formerly fuel-oil was used, and the brick muffle has been replaced by one of cast-iron. The first cast-iron muffle was made of individual blocks that were simply dropped into the old brick muffle-frame. A strip of $\frac{3}{4}$ by 2-in. iron is riveted on the inside of the frame, the lugs of the cast-iron blocks resting on top of these strips. It was found later that the muffle was equally satisfactory when made in larger sections, as shown in Fig. 6. These cast-iron muffles proved to be much cheaper than those made of brick, and a repair can be made in a few minutes, because it is not necessary to change the muffles. Each sintering machine is served by a fan having a capacity of 10,000 cu. ft. of air per minute, and the fan is driven by a 50-hp. motor. Extra dust-boxes were added between the machines and the fan so that any fine material that would be pulled through by the suction can be separated. These boxes catch the fine material so that it settles before it has a chance to cut the fan-blades, thus prolonging the life of the fans considerably. Under the sintering machines runs a belt-conveyor that catches any spill and removes it to an elevator, which carries it back to the feed-belt at the top of the building.

Two types of muffles for pulverized coal are shown in Fig. 6. The coal is fed to the roasters by a 41-in. diam. fan, with six $\frac{3}{4}$ -in. blades making 1200 r.p.m. The feed-pipe is nine inches in diameter; this is cut down to five inches for the return line. Directly over each machine there is a valve for feeding the coal to the muffle. There is also an auxiliary pipe-line to supply the extra air that is required to burn the coal. The coal-muffle is simple in construction and seems to work satisfactorily.

Three of the D. & L. machines are used for pre-roasting material such as lead matte, fine table-concentrate, flotation concentrate that can be moved on belt-conveyors, and any other fine or coarse material with a sulphur content too high to be eliminated successfully in one roasting operation.

The sintered material, or 'roast', discharges into standard-gauge railroad cars of 110,000-lb. capacity. The pre-roast material (partly sintered and its sulphur content reduced to 6 or 7%) is weighed and taken back to the sampling-mill for re-crushing, whereas the 'roast' (completely sintered and its sulphur reduced to less than 3%) is weighed and dumped directly into the blast-furnace bins. The bins at the sampling-mill that are used for the first-roast or pre-roast material are lined with 'gunite' three inches thick on the sides and four inches thick on the bottom. This gunite, a mixture of cement and sand, is shot by a 'cement gun' upon the sur-

face to be coated; it is reinforced by $\frac{1}{4}$ -in. rods and by a No. 8 wire-screen of triangular mesh. Spikes are driven into the sides of the bin and the reinforcement is hung from these spikes. The spikes, of course, also help to reinforce. Since the bins were lined with gunite, no more trouble has been experienced from the hot 'roast' setting fire to the wood. The bins are also fire-proofed on the outside by a layer of gunite about $\frac{1}{4}$ or $\frac{1}{2}$ in. thick reinforced with chicken-wire. This serves to preserve the wood from decay.

The fume and gas from the roasters pass to the Cottrell treater through a 9-ft. balloon flue, which connects with a spray-chamber and then with the upper part of a double-deck main flue. As the fume contains very little free acid, it was found difficult to obtain a good clearance in the Cottrell treater. It was found necessary to add moisture by means of a series of sprays. These at first were placed too near each other, so that they formed drops, thereby defeating the purpose, which was to create a mist. A spray-chamber was built. The sprays used now are made by the Spray Engineering Co.; they require 45 gal. of water per minute under a 225-lb. pressure. It is necessary to have this water filtered so as to keep the fine screen in the sprays from choking and to keep the sprays at maximum efficiency. The gas is cooled from 225° to 105°F., the relative humidity being about 50%.

THE COTTRELL TREATER consists of four sections, each of which has 64 pipes made of riveted steel, 12 in. diam. and 16 ft. long. The principle of the Cottrell tube is the electrification of suspended particles by the discharge of high-potential electricity into a stream of gas or fume. The individual particles become charged electrically so as to cause them to be attracted by the opposite polarity of the steel tube or pipe. The electric current is conducted within the pipes by a wire or chain made of No. 12 iron wire. The first step in the operation is a discharge of free electricity from the wire or chain into a stream of fume; these charges of electricity are immediately condensed upon the particles of dust, which then become repelled by the wire or chain, which is electrically of the same sign, and attracted by the wall of the steel pipe, which is of the opposite sign. The dust drops when it has accumulated thickly, but this detachment is expedited by rapping the pipes every two hours, which is done by a series of hammers suspended on a bar so that the movement of the lever causes them to hit the pipes.

The humidifying chamber is protected by a coating of gunite; nevertheless the flue shows the stains made by the acid produced by the reaction between the spray and the fume. When nine roasters are in operation the volume of gas is 140,000 cu. ft. per minute, and this gives a velocity of 11 ft. per second in the pipes. The treater was designed for five roasters, but the D. & L. plant has been increased to nine roasters, so at the present time the treater is somewhat over-crowded. On account of their acidity and temperature the roaster gases would be severe on the bags of the bag-house, consequently it has been found much more satisfactory to treat the roaster gases in the Cottrell treater.

The electrical equipment of the Cottrell treater consists of three rectifiers. The rectifier is mounted on the same shaft with the motor and generator. The current goes from the generator to the transformer of the rectifier, so that a direct current is supplied. The primary voltage is from 200 to 220, and the transformer ratio is about 436. The voltage used in the treater varies from 80,000 to 100,000. The rectifiers are arranged so that, by a series of switches, any rectifier can be used on any combination of treater sections. At the present time one rectifier is taking care of four sections. The motors are 25 hp. and the transformers have 10 kva. capacity. The field current for the generators is derived from a small motor-generator set. The steel outlet-flues were gradually eaten away by the moist roaster gases. These steel flues were replaced about a year ago by wooden flues made out

were filled with coke, one with coke-breeze, and one with antimonial skimmings. This list of contents suggests the variety of materials fed into the furnaces of the smelter.

The limestone comes from Ione, in Washington, on the Metaline branch of the Chicago, Milwaukee & St. Paul railroad and about 220 miles from the smelter. The Calédonia ore contains about 22 oz. silver, 6% copper, 6% lead, and 70% silica.

Each bin has two discharge-chutes, the material being held back by an ordinary arc-gate. Underneath each chute is a steel weighing-hopper, which is suspended from a Fairbanks scale. The man in charge of the weighing keeps in the several hoppers the exact amount of material required to make a complete charge for the furnaces. The ore, roast, flux, and coke, after being thus weighed, are discharged into the charge-car by the hopper-man,

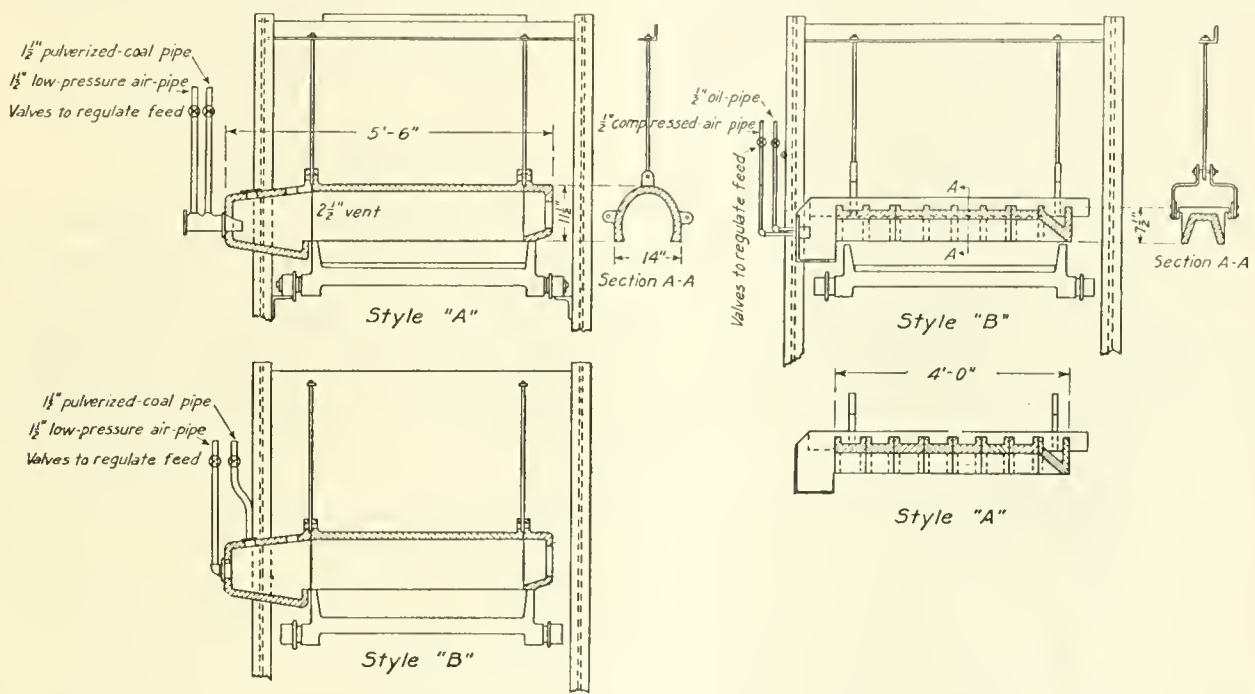


FIG. 6

of two-inch surfaced tongue-and-grooved stock. There are four of these outlet-flues and their cross-section is 30 in. by 9 ft., inside measurement. They are painted with P & B on the inside. The wooden flues have proved most satisfactory, and no more trouble has been experienced from leakages.

In the west gulch are the 24 charge-bins. The eight eastern bins are built of concrete and have a capacity of 3600 cu. ft. each. The central eight wooden bins, for silicious ores and limestone, have a capacity of 3500 cu. ft. each, and the western eight wooden bins are for coke, of which each holds 60 tons. On September 17, 1920, the date of my first visit to the smelter, five of the concrete bins held Dwight & Lloyd sinter, one contained flue-dust from the bag-house, and two were filled with slag. Of the wooden bins, two held limestone, two were filled with middling rich in siderite (iron carbonate), one contained flotation concentrate, two contained silicious ore from the Calédonia mine, one held dross from the lead refinery, six

who travels with it. The car contains two compartments, each of which holds a complete charge, weighing about two tons; it is hauled by a four-ton electric-trolley locomotive, which runs on a standard-gauge track to the blast-furnaces.

BLAST-FURNACES. There are four of these, each being 48 by 180 in. at the tuyeres. The crucible is 45 by 180 in. The furnaces have two tiers of steel water-jackets, the only brickwork in the column being a 6-in. filler of brick between the top of the second tuyere-jackets and the cast-steel top, which extends to a point about seven inches below the feed-floor. The feed-opening is 27 in. by 13 ft. The blast-furnaces have five jackets on each side and each jacket has two 4-in. tuyeres. The blast is supplied by a Connersville blower and the furnaces are usually run at a pressure of 32 oz. per square inch. The blower has a capacity of 100 cu. ft. per revolution and is driven at a speed of 145 r.p.m. There are also two Ingersoll-Rand turbo-blowers that have a capacity of 12,000

cu. ft. each and are driven at the rate of 17 r.p.m. These turboblowers work very satisfactorily in conjunction with the positive blower, and will take up any variation of load, so that the elements of pressure and volume can be regulated to a nicety. Each furnace uses between 6000 and 7000 cu. ft. of air per minute when smelting about 300 tons of charge per 24 hours. The charge normally is as follows:

	%
Roast	65 to 70
Limestone	4 to 5
Dross	5
Return slag and clean-up	3 to 4
Middling	5
Flotation slime	2½
Sintered flue-dust	5
Caledonia ore	7

To this is added coke in the proportion of 11 to 12½%. Such a charge as the above (taken from the record for one day) would average 30 to 35% in lead. It would take about four hours to go through the furnace. The slag is run into two settlers, one of 6-ft. diameter made of cast-steel 2½ in. thick, overflowing into another of 5½ ft. diameter made of cast-iron, one inch thick, and discharging into a Treadwell pot of 130-cu. ft. capacity. The slag-pot is handled by a 10-ton electric-trolley locomotive operating on a standard-gauge track. The lead is running off the furnace all the time except when the slag-level is lowered by tapping, and flows into a 4-ton brick-lined cast-steel pot riding on a car pulled by a crane, the pot being then lifted and emptied into the drossing-kettle, of which there are four, each of 50 tons capacity. The matte is tapped from the settlers into 4-ton cast-steel pots similar to the bullion-pot, and is also handled by the traveling crane. The charge-column is maintained at a height of about 8½ ft. above the tuyeres. The fume from these furnaces passes through steel flues underneath the feed-floor into a large settling-flue situated south of the blast-furnace building and extending a little west of the lead refinery. Here the settling-flue makes a 45° turn up-hill toward the bag-house and stack, and is gradually reduced in size. The cross-sectional area of the settling-flue, which has a 45° bottom, is 17 by 15 ft. The cross-section of the main flue going up the hill to the fan-house is 12 by 11 ft. 10 in. The fume is sucked by a large fan (of which there are two, one being held as a spare) to the bag-house.

THE BAG-HOUSE is built of brick and is 129 ft. long, 56 ft. wide, and 49 ft. 6 in. high to the eaves. The thimble-floor is 14 ft. 6 in. above the ground-floor, and above the thimble-floor the bag-house is divided into three sections, each containing 400 woolen bags, 30 ft. long and 18 in. diam., suspended in the line of their length. The bags are shaken every two hours by means of an eccentric device placed at the top of the bag-house and operated by an electric motor. While this operation is taking place in one compartment, the smoke is going through the other two. Usually, only two compartments or sections are used at the same time. The bags will last five or six years, when they will have to be replaced on account of leakage due to corrosion caused by sulphuric acid. Each section

below the thimble floor is divided into four chambers. The flue-dust is set on fire in these chambers and sintered. It contains about 74% lead and 8% sulphur. The bag-house also receives the fume from the furnaces of the lead refinery and the silver refinery. However, there has been a tendency in the summer time for the bag-house to get very hot, so that it is proposed to treat the refinery fumes in the Cottrell plant as soon as it has been enlarged. This will make a flexible arrangement.

THE LEAD REFINERY is an extension of the blast-furnace building, the total length of which is 396 ft. This building is served by two 20-ton Pawling & Harnishfeger traveling electric cranes. There is also a 10-ton crane in the west end of the building for use in case one of the other cranes becomes unavailable.

The equipment of the lead refinery is as follows:

- Four 50-ton drossing-kettles,
- Three 75-ton softening-furnaces,
- Four 50-ton desilverizing-kettles,
- Three 75-ton refining-furnaces,
- One 200-ton circular merchant furnace,
- One 30-ton by-product or residue furnace,
- Two Miller casting-machines,
- Eight retorting-furnaces.

This equipment is sufficient to treat 225 tons of refined lead per day. The molten lead from the blast-furnace is discharged, as described, into a cauldron the heat of which is brought up to 1000°F. so as to melt any free lead that may be in the dross, which is then skimmed off by a Howard press, a device invented by W. H. Howard of the American Smelting & Refining Co. This separates the molten metal entangled in the scum or dross. The fire is then taken off and air is blown into the kettles so as to oxidize the copper, which comes to the surface on account of the agitation, also forming a dross that is skimmed by the Howard press. The temperature of drossing is about 650°F. and the air is introduced until the lead almost freezes on top. The first skimming yields a dross containing about 80% lead and 15% copper, besides some sulphur and antimony. The copper content, of course, will vary according as the blast-furnace bullion is high or low in copper. The second skimming yields a product containing about 65% lead and 15% copper. When this operation is completed the lead will contain only 0.06% copper. The lead is then heated so that it can be pumped into either one of the three softening-furnaces. An ordinary centrifugal pump is used and the lead is carried to the softening-furnaces in a launder 75 ft. long made of ¾-in. boiler-plate with a lining four inches thick on each side, and five inches thick on the bottom. The lining is made of a mixture of two parts cement and five parts limestone, which should be of the size of coarse sand. The mixture is put into the launder as dry as possible and is well tamped. The idea of this launder is credited to John F. Miller, who had used it at Port Pirie, Australia. The launder is a very poor conductor of heat, so that during the pumping operation the lead runs nicely with a very slight fall into the furnaces, and there is practically no lead left in the launder when the operation is completed. The launder is not covered, and the opening is five inches wide.

In the softening-furnace the arsenic and antimony are removed. This usually takes about 20 hours, as the bullion contains around 1% antimony. It is necessary to bring the temperature of the lead in the furnace up to about 1650°F., when the antimony starts to oxidize, and the heat is cut down slightly. After sufficient antimony has risen to the surface and oxidized in the form of lead antimonate, the doors of the furnace are thrown open, the fire is taken out, and the bullion allowed to cool. The antimonial slag solidifies and is rabbled out of the doors. This material is sometimes caught in slag-pots; at other times it is dumped on the floor. The skim contains about 70% lead and 14% antimony.

When the bullion has thus been softened it is tapped into the de-silverizing kettles. The dross is skimmed and put back into the softening-furnace. Some fresh zinc, and that returned from the last operation on the preceding batch of bullion, is added. The underlying idea of

silver into as small a bulk of alloy as possible. The gold recovered at this stage is derived chiefly from the concentrate shipped from the Alaska Juneau mill in Alaska. It takes two operations to eliminate all the gold and silver. The desilverized lead contains 0.6% zinc, which has to be burned off in the refining-furnace. At the same time any remaining traces of arsenic and antimony are collected in the dross, leaving the refined lead ready for the merchant furnace, from which it is made into pigs by the Miller easting-machine. See Fig. 7. This was invented by John F. Miller, formerly superintendent of the lead refinery at Trail, B. C. It is necessary to eliminate the copper from the lead bullion because the copper has a greater affinity for zinc than for the other metals, consequently zinc will be wasted if the copper is not eliminated. The concentration of the zinc crust is between 45:1 and 50:1. The zinc-silver-gold crust is dumped into a bin at the retort

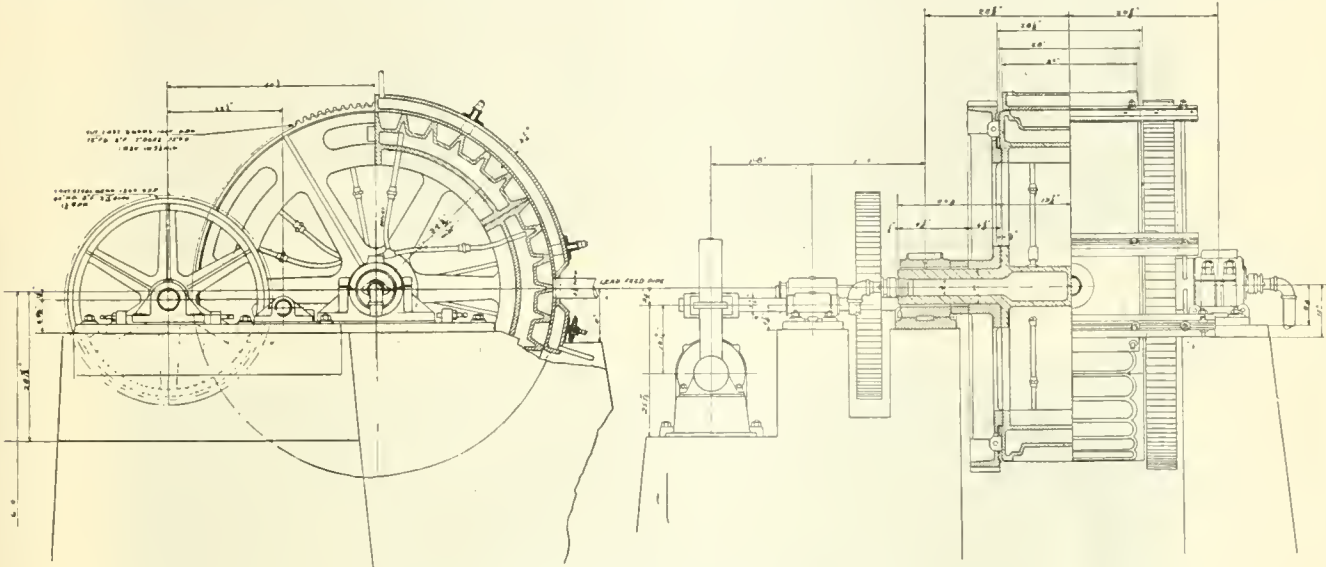


FIG. 7. THE MILLER LEAD-CASTING MACHINE

the zincing is the separation of the gold and silver by their preference for zinc rather than for lead. This is the old Parkes process. An alloy of gold, silver, copper, lead, and zinc, is formed and it rises to the surface of the lead, to be skimmed into a Howard press, which squeezes the lead out of the crust (a zinc-lead alloy containing 2000 oz. silver per ton) while this machine is suspended over the kettle (which has a capacity of 50 tons) by means of a crane. When the operation is finished, the crane swings the press to one side and dumps the crust, which is then broken by crowbars and shovels before it solidifies; then the press is returned to the kettle, the operators skim the bath of metal and ladle the crust into the press as before. One man holds the skimmer, a flat spoon, while two others employ wooden pushers to move the crust into the spoon. The zinc is stirred in by a double-shafted stirrer, the temperature being about 975° to 1000°F. The zinc-silver mixture is skimmed in the same manner as the lead dross, except that it is necessary to have a good pressure of air so as to squeeze all the lead possible out of the zinc crust, as it is necessary to concentrate all the gold and

department, where it is drawn into a ear and weighed in 1200-lb. charges. The skim is then shoveled into either a No. 9 Dixon retort, or a No. 30 Jonathan Bartley retort. Each retort is set in a Faber du Faur tilting furnace, in which the zinc is distilled. Pulverized coal is the fuel. The operation takes about seven hours. Old retorts are used as condensers and the zinc is drawn off at intervals, as it condenses, into steel-plate molds. The operator can tell when the zinc has been volatilized by pulling out an iron rod that fits into the hole in the top of the condenser. If any zinc remains, a blue-green flame appears. However, this operation has to be carefully done, otherwise there will be considerable loss of zinc, due to the burning of the metal. The zinc that is recovered is used again in the Parkes kettles. At the outset the desilverizing was done with zinc made at Great Falls, Montana. When the operation is completed, the condenser is pulled aside and the residue, called retort metal (consisting of lead containing the gold and silver, with traces of zinc, copper, and other impurities), is tapped, by tilting the retort, into a ladle, amid plenty of white smoke and blue-

green spurts of flame produced by the combustion of the zinc. A shower of snow—zinc oxide from the oxidation of the fume—falls all around. After the retort metal has been tapped into a tilting ladle it is poured into molds in the form of a bright cherry-red stream that gradually

coals in keeping the condensers cool enough, so that all the zinc vapor is condensed. A. Donaldson, the foreman of the refinery, inserted a 3-in. tile through the centre of the condenser. When the condenser is too hot the clay blocks are taken out of the ends of this tile, thereby exposing

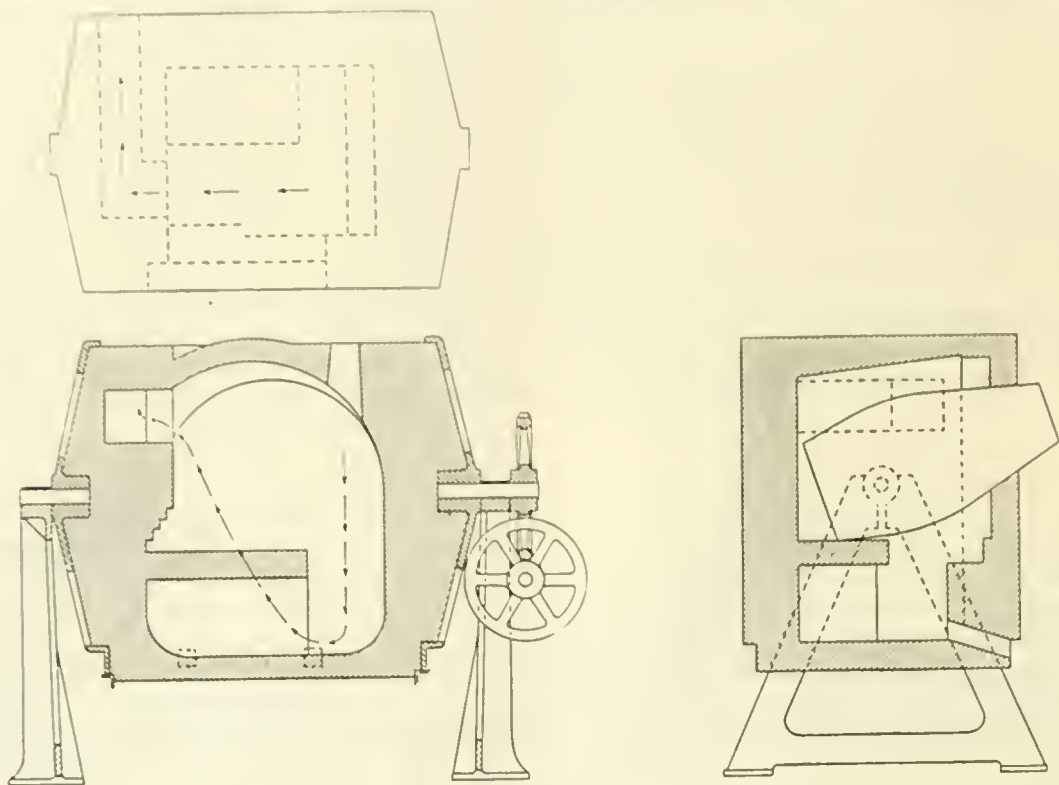


FIG. 8

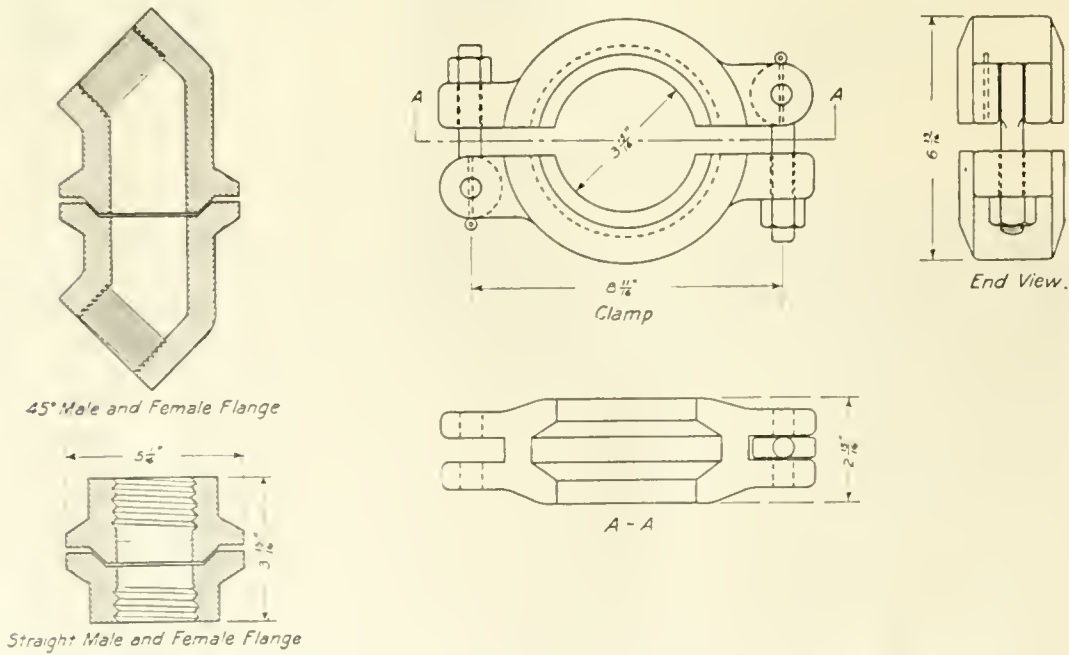


FIG. 9

darkens to a ruby tint, and finally to a leaden look. Then the furnace is tilted back and another charge is shoveled into it hastily. This is done by hand as rapidly as possible in order not to waste any heat and to avoid unnecessary burning of the zinc.

Difficulty has been experienced when using pulverized

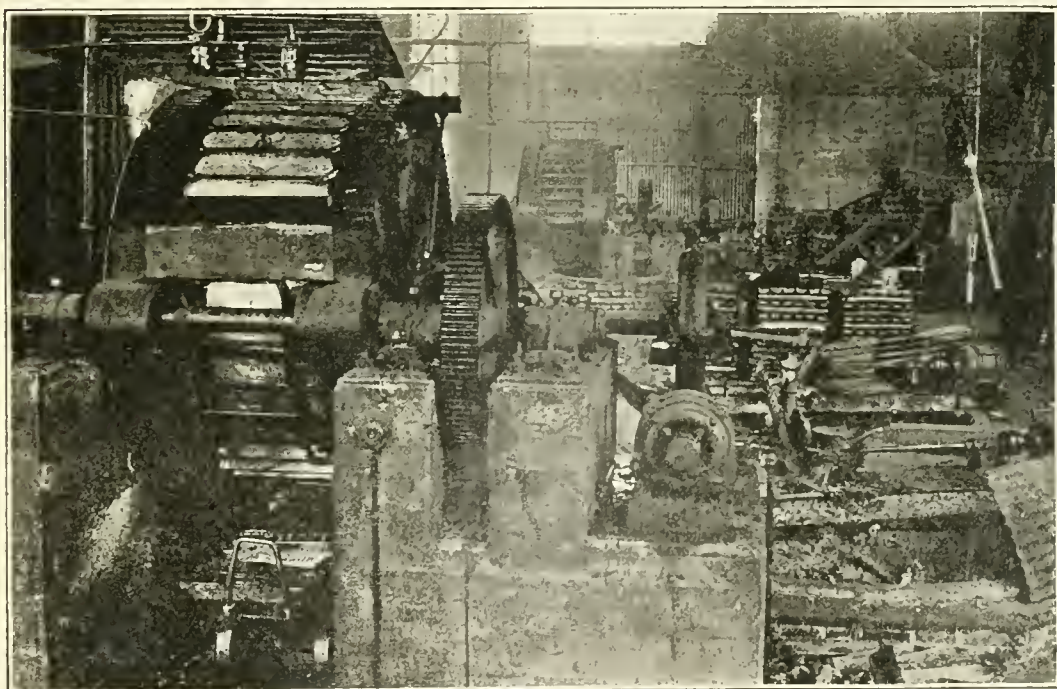
more surface to the fume. This idea has been most successful. A setting of the retort is shown in Fig. 8. The pulverized coal is fed through the top of the brickwork and the gases are taken out on the side, although some of the settings are slightly changed so that the gases of combustion can be taken out through a flue in the centre at

the back of the retort. When pulverized coal was substituted for fuel-oil, it became necessary to lower the bottom of the retort-setting about six inches. This gives space for the slag from the ash in the coal to accumulate and also gives a chance to pull the slag out when the metal is

retort is to be used, it is taken from the upper flue, placed immediately in its setting, bricked up, and fired at once, so that the retort is not allowed to cool. This practice has lengthened the life of the retorts, the average endurance being 35 heats, although on a trial of six special retorts,



LEAD CASTING-WHEEL AND MERCHANT KETTLE



ANOTHER VIEW OF THE LEAD CASTING-WHEEL

being poured from the retort. The flue carrying the gases of combustion is made in two sections, the upper one, which is used for annealing the retorts, being covered with steel plates. Holes in the arch of the lower flue allow the heat to circulate through the upper flue, thereby serving to anneal the retorts thoroughly. When a new

under working conditions, an average of 82 heats was obtained.

The retort metal contains 2500 oz. silver per ton and it requires seven hours to remove the zinc by distillation from the charge of 1200 lb. of zinc crust. The recovery of the zinc ranges between 80 and 85%. The retort metal

is then refined by cupellation in the silver refinery.

THE SILVER REFINERY. Here the lead and other impurities in the retort metal are separated from the silver in a cupelling furnace of the type designed by Frank Rhodes, formerly at the Omaha smelter. Heat is supplied either by the burning of pulverized coal or of fuel-oil. A blast of low pressure, about three ounces per square inch, serves to hasten the oxidation of the lead, which, as litharge, is skimmed into small slag pots, using a splitting-plate of cast-iron, thereby aiding the recovery of small particles of metal in the litharge. The metal that remains in the furnace is an alloy of gold and silver called doré; it is poured into molds by tilting the cupel, which will contain about 60,000 oz. at a time. The bars of doré weigh about 500 oz. Troy. The cupel itself is lined with a mixture of five parts limestone, three parts clay, and two parts cement. The limestone is crushed to the size of coarse sand. These materials are mixed thoroughly with a little water and tamped very carefully into the frame of the cupel. Around the sides there is a lining of magnesite bricks placed on end.

The doré ingots, in charges of 10,000 oz., are parted in cast-iron kettles by means of sulphuric acid of 66°B. strength. The silver is dissolved and the resulting silver-sulphate solution is drawn into lead-lined vats. Here copper bars are suspended in the liquor by means of 'corrosion' hooks and steam is introduced so as to cause the solution to boil. The silver is precipitated on the copper, which in turn goes into solution as sulphate; the silver is deposited in the form of 'cement silver', which is filtered, washed in boiling water, dried, and then melted in a Monarch double-chambered tilting furnace, fired by oil. The silver is 999 fine; it is cast in bricks of 1250 oz. and shipped by express to San Francisco. In producing 1000 oz. of silver it is customary to use 125 lb. of acid and 21 lb. of copper. The insoluble residue, after the silver has been dissolved in the parting-kettle, contains the gold in the form of a brown powder, which is boiled to remove any sulphates and is then melted in a graphite crucible, as at Selby.†

The copper solution is pumped to an adjoining building, where it is evaporated sufficiently to cause the copper sulphate to precipitate in crystals; these are re-dissolved in water and again crystallized on strips of lead in another lead-lined vat. The copper sulphate is pretty stuff, and remarkably pure; it is an industrial sapphire that deliquesces readily; it is sold either to the farmers, who use it for spraying, or to the flotation mills. For a time it found a local market at the Interstate Callahan mill, now idle, which used a selective-flotation method. The mother liquor is evaporated to 66°B. and put back into the main acid-storage tank.

In the lead refinery there is another reverberatory furnace, named the residue or by-product furnace, in which the different drosses are treated. The products from this furnace are lead bullion, copper matte, and an antimonial slag. Galena is added to this furnace to supply the sul-

phur required to put the copper into a matte, which contains 25% copper and 40% to 50% lead. The antimonial slag contains 50% lead and 18% antimony; it is smelted in one of the blast-furnaces with an equal amount of blast furnace slag, together with refinery-furnace drosses and lead ore poor in silver. The antimonial content of the 'hard lead' is controlled so as to suit the requirements of the trade. The Bunker Hill 'hard lead' contains 18% antimony; it is the base of most of the common anti-friction metals, as well as of the type used in printing.

The dimensions of the steel pans for the reverberatory furnaces in the lead refinery are 21 ft. long, 12 ft. wide, and 3 ft. 4 in. high. The distance from the bottom of the pan to the top of the brick arch is 6½ ft. The brick-work is protected by water-jackets made out of 15-in. channel-irons and ¼-in. plate, which is welded to the channels. The length of the side jackets is 20 ft. 6 in. and the length of the end jackets is 11 ft. 6 in. There is also a simple flange and clamp used for connecting pipes through which lead is to be pumped. The clamp is arranged so that by tightening one bolt the flange is made tight. This is convenient, as the pipes and clamps are quite hot and the old-fashioned flanges and clamps are very awkward to handle. It takes some time to break the old flange, and in the meantime the lead is likely to solidify in the pipes. The credit for this coupling is due to Louis Anderson, the head pipe-man, an old employee of the Bunker Hill Co. This flange and coupling are shown in Fig. 9.

The coal-pulverizing plant has the usual Bonnot equipment. The screw-conveyors under the storage-bins discharge onto a belt-conveyor running under an electric magnet and into a weighing-hopper. The coal is then fed into a 4 by 30-ft. dryer, which is fired direct, and from here the coal is conveyed by a screw-conveyor to two one-ton storage-hoppers over two Bonnot pulverizers. The pulverizers have a capacity of 1½ tons per hour. The fine coal is sucked by a fan from the pulverizer into the main storage-bin, where it is settled by a Bonnot 'collector'. There is one distributing fan for the silver and lead refineries, and another for the D. & L. roasters. An air-float valve regulates the speed of the motor that drives the screw-conveyors from the main storage-bin into the distributing fans; it is arranged so that when more burners on the line are opened, more air is supplied there; consequently, this float-valve accelerates the screw-conveyors and increases the quantity of coal fed into the line, and, similarly, when coal-burners are turned off the quantity of air drawn is lessened and the speed of the screw-conveyors is decreased. Thus the mixture of air and coal is kept constant. The mixture in the distributing pipe is 50 cu. ft. of air to one pound of coal, and an additional 150 cu. ft. of air is supplied at the furnace by an auxiliary blower in order to make perfect combustion. About 85% of the pulverized coal will pass a 200-mesh screen.

The average consumption of fuel-oil on the D. & L. roaster is 1½ gal. per ton. This figure takes into account only the actual tonnage of material roasted, and does not

† 'The Selby Smelter', by T. A. Rickard. 'M. & S. P.', April 8, 1916.

allow for the extra tonnage caused by double-roasting some of it. The same work used to be done by 7 lb. of pulverized coal.

A saving of time was made when pulverized coal was substituted for oil on the retorts. The average quantity of oil used on the charge was about 44 gal., whereas the

gives the smelter an ample supply of domestic water. The smelter and Sweeney mill are protected by an electric system of fire-alarms. First-aid cabinets are maintained all through the plant, and it is a strict rule that all cuts, no matter how slight, must be immediately dressed, so as to avoid any possibility of blood-poisoning. The smelter has its own sewerage plant.

M. H. Sullivan is superintendent, A. F. Beasley, assistant superintendent, S. Butler, general foreman of the roasters and blast-furnaces, A. Donaldson is foreman of the refineries, J. B. Schuettenhelm is in charge of the Cottrell treater, roaster charges, and testing department, P. C. Feddersen is chief chemist, and G. C. Gage is in charge of the smelter office.

NOTES. A few further scattered notes may be added: During the War the smelter was enclosed within a barbed-wire fence and protected by armed guards. No trouble, however, was experienced. At

quantity of pulverized coal is 680 lb. In the lead refinery 215 lb. of coal is used per ton of refined lead.

The slack coal is purchased from the Central Coal & Coke Co. and the Gunn-Quealy Coal Co. It comes from Rock Springs, Wyoming, which is 1030 miles distant. The coke comes from Sunnyside, Utah, 1080 miles from the smelter.

Recording pyrometers, thermometers, and pressure-gauges regulate all operations. The smelter has a four-wheel Link-Belt locomotive-crane that moves all the coke and limestone into stock, besides shifting the slag, matte, and dross. There are also three locomotives, the newest one a six-wheel American locomotive, weighing 60 tons and oil-fired. Nineteen steel ears owned by the company are used in the daily operations; most of these being employed for moving the D. & L. roast, either to the sampling-mill, for re-crushing, or to the charge-bins. The smelter has three water systems, for domestic purposes, furnace use, and fire protection. The valves on the centrifugal pumps are arranged so that water can be drawn from any source of supply and pumped into any of the distributing lines. The water is obtained from the Bunker Hill system, and there is also a new 12-in. water-line that has just been laid in Government gulch, which

that time most of the Bunker Hill silver went to the Orient, for paying the Indian cavalry that conquered Mesopotamia for the British. The lead was sold chiefly to the Chinese, the special pigs, weighing 200 lb. apiece,



LEAD INGOTS IN RAILROAD-CAR



A WAGON-LOAD OF SILVER; 65 BARS WORTH \$83,147

destined for China being marked with Chinese characters instead of the usual stencil; they were shipped by the Robert Dollar Company from Seattle.

On the day of my first visit only one blast-furnace was running; usually two are kept busy. The four furnaces could treat all the lead ore produced in the Coeur d'Alene, their capacity being out of proportion to that of the refinery. It is comfortable for the men to have an

idle, and cool, furnace on either side of the one they are tending. On the charge door a Bristol recording thermometer registers the temperature of the gases discharged from the furnaces; it serves also to record the number of charges, by means of the dip on the chart made at the moment when a car is dumped into the furnace.

It is pleasant to stand before the blast-furnace and watch the stream of molten lead pouring into the kettle and then watch the slag being tapped from a higher outlet, with much spluttering, into a pot. The slag-dump, after only three years of operation, already fills the eastern gully and upon it there has been built a garage to hold the six automobiles used by members of the staff.

The final casting of the refined lead is likewise attractive. The market lead is pumped into the casting-machine, the overflow running back into the kettle. The division between the molds produces a superfluity. The metal in the conducting-pipe is kept hot by means of an electric heater consisting of a coil of wire around the pipe. The casting-machine is a wheel, water-jacketed inside and outside; on its periphery are the molds. The lead is pumped through a hole in the outer water-jacket, so that by the time a mold comes round to the bottom the metal in it is cool enough to fall out, being loosened by natural contraction. The pigs are stenciled 'BUNKER HILL'; they are weighed and check-weighed before being loaded into a railroad-car. The tally shows the destination of the shipment. The one I read was to "Hoyt Metal Co., Perth Amboy, N. J.", and bore the further inscription: "This car contains B. H. lead 99.99 per cent pure". As the pigs of lead fall with a dull thud upon the loading-truck it is a satisfaction to realize the end of the many and varied operations through which the metal has passed on its way from the rock in the mine to the railroad-car at the siding.

The lead from the Bunker Hill goes direct to the consumer. Other mining companies in the Coeur d'Alene have to follow a more devious procedure; for example, the Hercules concentrates its ore at Burke, Idaho; smelts it at Northport, Washington; and refines the bullion at Carnegie, Pennsylvania. The astonishing diversity of the industries using lead is suggested by the following list, given to me by Mr. Bradley, from among those who buy the Bunker Hill lead:

Remington Arms U. M. C. Co...Bridgeport, Conn.
 Simplex Wire & Cable Co.....East Cambridge, Mass.
 The Okonite Co.....Dundee, N. J.
 Ford Motor Co.....Detroit, Mich.
 Conley Foil Co.....New York, N. Y.
 Peters Cartridge Co.....Kings Mills, Ohio
 Union Sm. & Ref. Co.....Newark, N. J.
 Ellenwood & Doyle.....New York, N. Y.
 Norton Company.....Worcester, Mass.
 Grasselli Chemical Co.....Grasselli, N. J.
 Matheson Lead Co.....Long Island City, N. Y.
 Robert Dollar Co.....Hankow, China
 E. I. du Pont de Nemours Co....Newark, N. J.
 Standard Underground Cable Co.Perth Amboy, N. J.
 Electric Storage Battery Co....Philadelphia, Pa.

Anaconda Copper Mining Co....Black Eagle, Mont.
 Pacific Metal Works.....Portland, Ore.
 W. H. Harrison.....Great Falls, Mont.
 Latimer Goodwin Chem. Co....Grand Junction, Colo.
 Eagle Picher Lead Co.....Cincinnati, Ohio
 Winchester Repeating Arms Co..New Haven, Conn.
 Standard Tin Foil Corp.....Philadelphia, Pa.
 Great Western S & R Co.....San Francisco, Cal.
 Pacific Metal Works.....San Francisco, Cal.
 Nathan Trotter & Co.....Philadelphia, Pa.
 General Electric Co.....Schenectady, N. Y.
 Crerar Adams & Co.....Chicago, Ill.
 U. S. Foil Co.....Louisville, Ky.
 Hendrie & Bolthoff.....Denver, Colo.
 American Brass Co.....Kenosha, Wis.
 Cutler Bros.New York, N. Y.
 Standard Rolling Mill Co.....Brooklyn, N. Y.
 Carnegie Steel Co.....Pittsburgh, Pa.
 Northwest Lead Co.....Seattle, Wash.
 Gardner Metal Co.....Chicago, Ill.
 National Lead Co.....Brooklyn, N. Y.
 Windsor Mfg. Co.....Milwaukee, Wis.
 Sherwin Williams Co.....Kensington, Ill.
 Hazard Mfg. Co.....Wilkes-Barre, Pa.
 Wensley Metal Products Co....Denver, Colo.
 John Wahl Commission Co.....Utica, N. Y.
 A. Wilhelm Co.....Reading, Pa.
 American Rolling Mill Co.....Middletown, Ohio
 Michigan Sm. & Ref. Co.....Detroit, Mich.
 Rockwood Sprinkler Co.....Worcester, Mass.
 General Fire Extinguisher Co...Atlanta, Ga.
 United Lead Co.....Perth Amboy, N. J.
 Hoyt Metal Co.....Perth Amboy, N. J.
 Carnation Milk Products Co....Kent, Wash.
 Metals Warehouse Co.....East St. Louis, Ill.
 Adam Hope & Co.....Hamilton, Ont.
 Lima Locomotive Co.....Lima, Ohio
 Southern Pacific Co.....Sacramento, Cal.
 Doehler Die-Casting Co.....Toledo, Ohio
 Norfolk & Western R. R. Co....Roanoke, Va.
 Louisville & Nashville R. R....So. Louisville, Ky.
 United Iron & Metal Co.....Canton, Ohio
 Nat. Transit Pump & Mfg. Co....Oil City, Pa.
 Chicago Bearing Metal Co.....Chicago, Ill.
 Hammer Bros. White Lead Co...East St. Louis, Ill.
 Standard Sanitary Mfg. Co.....Louisville, Ky.
 National Conduit & Cable Co....Hastings-on-Hudson, N.Y.
 H. Kramer & Co.....Chicago, Ill.
 Washburn Wire Co.....117th St., Harlem River,
 N. Y.
 Safety Insulated Wire & Cable...Bayonne, N. J.
 White & Bros., Inc.....Philadelphia, Pa.

The names of the buyers indicate the various uses to which they put the lead, namely, for shot, bullets, bab-bitt and other anti-friction alloys, lead foil, sheet lead, pipe, casing for electric wires, white and other paints, lining for acid-vats and electrolyte cells, solder for cans, and plumbing supplies.

The smelting at this plant is characterized by a high proportion of lead in the charge, from 30 to 35%, and by a very low zinc content, averaging less than 4%. Looking at this extensive and comprehensive smelting plant, it is pleasant to realize that there is a splendidly productive mine back of it.

Notes on Mining in British Columbia During 1920

Special Correspondence

There can be no doubt that the weakness of the copper market is having its effect on the industry in British Columbia. How serious this is to be depends entirely on the length of time it takes for world conditions to adjust themselves. It serves no good purpose to attempt to blind ourselves to the facts; the outlook is not promising. With the Granby company's forces at Anyox materially reduced; with the Britannia Mining & Smelting Co., according to authentic report, devoting itself to development of its properties to the exclusion of production and shipment, with a cutting down of the working force; with the Canadian Consolidated Mining & Smelting Co. at Trail declaring that only necessary construction will be proceeded with; and with the Canada Copper Co., whose Copper Mountain mines at Allenby are just ready for production, announcing that operations must cease until the market improves, it is clear that the large producers have concluded that it is impossible to produce copper at a profit at the present time.

That many of those in close touch with the situation declare that it cannot last for long, and that as soon as copper climbs back to its normal place all these companies will resume both production and development, constitute the silver lining to the cloud. In passing, it is interesting to direct attention to the paramount importance of copper in considering mining in this Province. When that metal slumps, its effect is serious wherever there is a mining industry, but in this Province the result is calamitous, as, being without an iron and steel plant of consequence and there being no production in iron, it hits at the very backbone of the industry.

Taking the year 1920 all through, up to the middle of December, British Columbia has not done badly in point of the production of its metal mines. From the general information available, it appears that the output of copper for the twelve-month will be about equal to that of 1919, that is, 42,459,339 lb. For the first nine months of the year, it must be borne in mind, the larger companies, for the most part, maintained their production at a high level. The Britannia Mining Co., for instance, milled as many tons of ore as it did in 1919 before the copper market fell into the doldrums. The price having fallen to 14c. per pound in New York, production was cut down, otherwise the tonnage treated by flotation in the concentrating mill at Britannia this year might have established a new record for the plant. These latter observations tell the story of the operations of the Granby Consolidated Mining & Smelting Co. at Anyox. Not until the latter part of the year was the output reduced, so that it is expected that the figures for the period will not be unfavorable in comparison with those of the previous year.

As to the Consolidated Mining & Smelting Co., at Trail, it is not at present a large producer of copper. Its returns in this respect are likely to be unfavorably affected because of the fact that the Rossland mines have not been shipping largely. With a number of independent shippers, although none contributing in quantity and regularly, and with some shipments of importance from the Mandy mine of Manitoba, the Trail smelter returns, however, may contain a surprise.

This company, in a greater degree than heretofore, is turning its attention to copper. The construction of concentrating plants at the Old Sport claims, on Quatsino sound, and at the Sunloch, Jordan river, both on Vancouver Island, had been planned for 1920, but the cost of labor, supplies, and machinery were too high as compared with the average price of the metal and the projects were permitted to stand. A start on these plants may be looked for during the new year. The intervening time has not been lost, as development was continued; working openings have been driven on both properties and diamond-drilling so pressed that much greater reserves of ore have been exposed.

The Tidewater Copper Co., operating the Indian Chief group at Sidney inlet, Vancouver Island, is an enterprise to which special attention should be directed. Through the adoption of a definite policy this company has placed itself in a position to mine and ship considerable quantities of concentrate over a long period, with every prospect of developing further resources as the work continues. During the past two years a sufficient body of ore has been blocked out to furnish 300 tons for treatment daily for two years by a mill which has been reconstructed, enlarged, and improved. In connection with the latter, a battery of Peterson flotation cells and an electrical plant for driving all machinery, including the air-compressor, have been installed. Two creeks have been used for the generation of power; the necessary plant has been provided.

The Kamloops district will show a drop in copper production this year because of the closing down of the Iron Mask mine. This took place last April, and since that time a start has been made in the installation of a new water-system and other improvements to the plant. The shaft has been straightened, new concrete foundations to the head-frame provided, a new conveyor built from the shaft to the mill, and increased storage-tanks constructed for the treatment-liquids.

With reference to the 1920 production of gold, there probably will be a decline in comparison with the previous year. In placer mining there has been considerable activity in the Cariboo, and farther north and north-east. In 1919 the placers of British Columbia produced 14,325 oz. of gold. That the lode gold mining

will not show as satisfactory results as in 1919 is assumed from the fact that the Rossland mines have been quiet and the Nickel Plate mine had been slowing down for some time prior to the final close of the mine. This occurred some two or three months ago and was the result of high costs and diminished purchasing power of gold. It is not advisable, however, to make anything but a qualified prediction in respect to gold, because, while it is true that the Rossland mines have not been producing, it must be remembered that they did not do much in 1919; and, although it is a fact that the Nickel Plate cannot be depended upon for a large production, it should be borne in mind that there will be a considerably greater return in gold from the output of the Premier mine in the Salmon River district. The lode-gold production for 1919 was 152,426 ounces.

Notwithstanding that the silver production of the north-east coast of British Columbia, where is situated the Dolly Varden mine, will be substantially greater than in 1919, it looks as though the total 1920 output will be less than it was in the previous year. The whole of the provincial coast and the Boundary district will show about the same production for this year, or perhaps a little better than in 1919. If the figures are higher the credit will have to go to the Premier and the Dolly Varden mines, especially the latter, which has been operated on a large scale throughout the year and from which a large quantity of high-grade silver-bearing ore has been shipped. But the Sloean district will be found to be short in production, and, in order that the significance of this may be properly understood, it may be said that in 1919 the northern coast produced in silver, 920,413 oz.; the Boundary-Yale district, 231,599; East Kootenay, 274,134; and West Kootenay, 1,799,229. The total for the Province was 3,403,119 oz. The richest silver mines of West Kootenay are in the Sloean district. What have been the conditions responsible for the slump? Two circumstances have served to restrict output. One was the lack of labor in the early part of the year and the other the discontent which developed later among the miners, finally resulting in a strike called by the 'One Big Union'. If the workers aimed to tie up the mining industry they were successful beyond a doubt. The operators refused their demands with the one exception of the Silversmith company, operating the old Sloean Star, and for months only that property was active. The situation now has changed. The lumber business has fallen off, logging is at a standstill, and there are plenty of men for the mines. Latest advices are that work has been resumed on most of the well-known properties of the district, but the damage, as far as the year's production is concerned, has been done and the record of production will suffer.

The production of lead and zinc depends largely on the output of the Sullivan mine, of Kimberley, which is treated at the Trail smelter of the Consolidated Mining & Smelting Co. This mine has been extensively developed and it has been yielding greater quantities of ore so that it is possible the lead production of the

Province, which in 1919 was 29,475,968 lb., will be about the same for 1920. There is no doubt that there will be a falling off in the product of the Sloean district so that much depends on the showing made by the company's mines. In regard to zinc the same remarks apply, except that it would appear likely that 1920 will show an increased output of that metal. Again the Sullivan mine is responsible, zinc ores being largely mined at Kimberley during the past twelve-month. In 1919 East Kootenay produced 46,460,705 lb. of the total 56,737,651 pounds.

Taking it as a whole the foregoing is not as bright a review as it has been possible to give for several years, but it is not unsatisfactory. For some time exceptionally high prices in copper, silver, and other products of the minerals of this Province were enjoyed and the fullest advantage was taken of the opportunities thus afforded for development. Consequently the industry has advanced far beyond the point it had reached five years ago. The present slump in the market, the existing unsettled conditions, and the results, should not be viewed with alarm in view of the richness of British Columbia's proved resources.

AN AUSTRALIAN MINING SCANDAL. Quite a sensation has been caused throughout Australia with regard to what has transpired in connection with a mining property acquired and held at Badak, in the Malay peninsula, by Victorian speculators. The reports at first received regarding this property, based on extensive borings, taken first by one individual and subsequently supported by another, were to the effect that a very rich run of tin had been found. These reports were of such a nature that, as a result of the wildest speculation, £10 shares in the Victorian syndicate were sold at as high a figure as £2000. Soon afterward, however, following the receipt of very different reports, a change came o'er the spirit of the dream of the rash speculators, and now it is apparent that either a big mistake has been made or something equally, if not more, unsatisfactory has occurred. The latest report from Malay is by I. Boadle, who has been boring on the Badak property under the supervision of H. F. Scarborough, a representative of the Victorian company specially sent over to look into matters. Mr. Boadle says he put down 86 bores, all of which bottomed. He carefully measured and washed the material from each bore, but in no case, he states, could he find ground that would pay to work, and in many bores there was not even a trace of tin. In the meantime the Victorian company has taken the unusual course of asking the Melbourne Stock Exchange not to call the shares of the company 'on Change' until such time as authentic and reliable reports have been received from the company's general manager, who was then on his way for Penang, and the Exchange has expressed its approval of a suggestion that the State government should hold an inquiry into all the affairs of the Badak company with a view to placing the responsibility if it develops that any irregularities are proved.

Karl Eilers v. Guggenheims

The following reply to Mr. Eilers' charges was made by Edgar L. Newhouse, chairman of the board of the American Smelting & Refining Co., as a return to the petition for a writ of mandamus. We take it from the 'Engineering and Mining Journal' of January 1, having received no copy directly.

. . . The original election of Mr. Simon Guggenheim to succeed Mr. Daniel Guggenheim as president of the company on January 21, 1919, represented the free and unanimous choice of the directors of the company. It is not true that the board of directors were given no opportunity to express any wish in the matter. The re-election of Mr. Simon Guggenheim as president of the company thereafter likewise represented the free and unanimous choice of the directors, save in the case of Mr. Eilers.

It is true that since their association with the company the Messrs. Guggenheim, or some of them, especially Mr. Daniel Guggenheim, Mr. Murry Guggenheim, and Mr. Simon Guggenheim, have exerted a weighty influence in the counsels and management of the company. It is not true that the Messrs. Guggenheim, or any of them, dominated the directors and officers of the company in the injurious and objectionable sense in which the term is employed in the petition. Such position of influence and authority as they held was altogether due to their great abilities, their unusual knowledge of the business and their singular qualifications as directors in the enterprise. It was in no wise due to arbitrary methods or to artificial means of control. . . .

It is not true that the Messrs. Guggenheim, though continuing to act as directors, ceased to hold stock in the company except in a negligible amount. On the contrary, they have always been substantially interested as stockholders in the company.

The only member of the Guggenheim family who is now an officer of the company is Simon Guggenheim, who is president and is the owner of over 20,000 shares of the common stock of the company and, so far as deponent has been able to ascertain by investigation, is the largest single stockholder of the company, the total holdings of said Simon Guggenheim and his wife in common and preferred stock being in excess of 28,000 shares. Isaac and Daniel Guggenheim are directors but not officers, and draw no salaries. Their aggregate holdings of stock of the company are in excess of 8,000 shares. It is not true that any of the Messrs. Guggenheim ever received salaries from the company while not rendering commensurate service. . . . No salary is paid by the company to any of the Messrs. Guggenheim other than to the president of the company, Mr. Simon Guggenheim. . . . Especially is it denied that the Messrs. Guggenheim, or any of them, during their association with the company acted in disregard of the interests of the corporation or sought to employ it to serve their own ends.

The facts as to the company's activities in Bolivia are that prior to 1910 the company had never smelted tin nor had tin been smelted in the United States to any substantial extent by anyone. The company was then engaged in smelting and refining silver, copper, lead and other ores. In 1910 Messrs. Newhouse and Stewart, officers and directors of the company, went to South America for the purpose of obtaining contracts for the smelting of ores other than tin, at the company's plant at Tacoma, Wash. They did not while there investigate mining properties of any kind for purchase. While in Bolivia they became convinced that it would be to the advantage of the company to add the smelting of tin to its other smelting activities and upon their recommendation the company built a tin smelter at Perth Amboy, N. J., and entered into contracts with tin mines in Bolivia for the smelting of their ores and that business has been carried on up to the present time. It is true that a number of years later an examination of one or two tin properties in Bolivia was made for the company, but a majority of the board was opposed to the company's investing money in any tin mines in South America, and no such mines have ever been acquired by it. None of the property in Bolivia so examined for the company, or the purchase of which was considered by directors and officers of the company, was ever purchased by the Guggenheim Brothers, or by any member of that family. I deny that any demand was made by directors of the company that the company be allowed to share in Guggenheim Brothers' operations in Bolivia, or that any such demand was refused by the Messrs. Guggenheim.

With reference to the Premier silver and gold mine in British Columbia, the company's interest in making any investment therein was primarily to insure to itself the smelting and refining of the ore from that mine. Officers and directors of the corporation, other than the Guggenheims, were opposed to the investment of a sum of money as would be required to purchase a one-fourth interest in the mine which was the interest offered to the company by owners of the property. On the other hand, it was necessary for the corporation to arrange for the purchase of at least a one-fourth interest, if any interest was to be acquired, as the sellers did not desire to sell a smaller interest. The smelting company therefore solicited, through its Mr. Gness, the head of its mining department, the Guggenheim Brothers to purchase a one-half of the one-fourth interest offered, thereby relieving the company of the necessity of purchasing more than the remaining one-half of the one-fourth and this arrangement was informally approved by all of the directors of the company except possibly Mr. Eilers, and I have no recollection of Mr. Eilers ever objecting at the time or until this action.

The allegations of the petition in respect to sales of copper are incorrect and misleading. By far the greater amount of copper sold by all large copper producing and

selling company is sold for future delivery, and owing to the custom of the trade and the requirements of the copper market it is impossible for any company having a large output of copper to sell more than a comparatively small part of its production by current sales, such as are possible in other metals. Moreover, the volume of copper to be sold by the company has included, since about the year 1908, not only its own copper, but also copper sold by it as selling agent for a number of large copper producing companies, the selling agency arrangement having been made as part of arrangements to smelt and refine the ores of such companies, so that this company receives, in addition to its profit from its operations upon the ore, a separate and additional commission for the sale of the copper. The selling agency arrangement provided that the company sold its own copper, together with the copper of the companies for which it acted as selling agent, all sales of copper being pro-rated against the total amount of copper available for sale at any particular time, including the company's own copper. The net proceeds of the commissions paid to the company for its services as selling agent for other companies amounted, in the period from Jan. 1, 1913, to Sept. 1, 1920, to a sum in excess of \$10,000,000, and the conducting of such agency proved to be, during normal times, a source of large profit to the company. The existence of the agency, however, increased the necessity and volume of forward sales of the company's own copper, and particularly in the abnormal period following the outbreak of the European war it is true that some losses were suffered from this source. These quotational losses were due almost entirely to the existence of the selling agency. The statement made by Mr. Hills, the comptroller, as of Oct. 31, 1920, which is apparently the statement referred to at folia 28 of the petition, shows that from Jan. 1, 1912, to Oct. 31, 1920, the net proceeds from the selling agency amounted to \$10,046,409, and that from this should be deducted quotational losses incurred during the same period amounting to \$4,594,824, leaving an apparent net profit for the period on the operation of \$5,451,585. But this apparent profit will at present prices of copper be more than wiped out by quotational losses which will be suffered if the present dull copper market continues.

The statement that in April, 1920, as the result of a policy of withholding copper from sale, the company had on hand approximately 160,000 tons of refined copper is absolutely untrue. On May 1, 1920, the company had on hand for its own account 26,855 tons of refined copper. This accumulation was not due to any policy of withholding copper for sale, as the company had used its best efforts to sell all the copper it could, but was due, first, to lack of demand because of the fact that all consumers of copper were overstocked; second, to the fact that during the war production was greatly stimulated because of the war demand, and a large amount of copper ore came through after the signing of the Armistice in a volume much larger than during normal conditions; third, to the fact that labor and railroad conditions dur-

ing the war and after the signing of the Armistice were such as to lengthen the period between the delivery of ore to the company and the arrival of the refined copper at tidewater; and, fourth, to the fact that the company was not free to sell its own copper, independently of the copper of the companies for whom it acted as selling agent, since, under the selling agency agreements, the company's own copper had to be sold pro rata with that of all of the companies for whom the company acted as selling agent, and the aggregate amount which thus had to be sold was much greater than the market has been able to absorb during the conditions existing since the signing of the Armistice. All of these were conditions which were due to the abnormal times and for which the officers of the company were in no way responsible. The conditions experienced in these abnormal periods by this company have been common among companies in the same business.

The officers and directors of the company have from time to time during the past two years made efforts to work out a modification of the selling agency contracts which would leave the company the profits from its commissions as selling agent in normal periods and at the same time leave it free to sell its own copper independently during times of abnormal conditions, but although the greatest efforts were made by the company's officers to that end, this finally appeared not to be practicable, and as the end of the abnormal conditions are not yet in sight, it was determined by the board of directors during the month of November, 1920, to terminate the selling agency, which was accordingly done.

In other words, the company's selling agency was originally attractive and profitable to it, and during normal times resulted in large net profits accruing from the selling commission. The unprecedented abnormal conditions which arose during the war and again since the signing of the Armistice have created a situation which could not have been foreseen, and the result of which has been to offset quotational losses against the profits thus accruing, and no one can now foresee when normal conditions in the industry will return. The company's board of directors has, in order to prevent further losses from this source, deemed it to the advantage of the company to terminate the selling agency, so that hereafter the company will sell merely its own copper, unrestricted by obligations to sell the copper of any other company.

The various changes in the board of directors and in the officers of the company, referred to in the latter part of the seventh paragraph of the petition, took place, but the reasons therefor, and the inferences therefrom as stated in the petition, are wholly imaginative.

IT IS STATED that an American-owned manganese mine situated on the Gulf of California at Punta Aguja peninsula is now operating and is shipping 200 tons of high-grade ore monthly. The ore extracted runs from 20 to 92% manganese, averaging about 48%. Since the product is shipped to Chicago at present, it is impracticable to send other than high-grade ore.

REVIEW OF MINING

FROM OUR OWN CORRESPONDENTS IN THE FIELD

ARIZONA

NEW EQUIPMENT AT THE KAY COPPER MINE.

PRESCOTT.—A receivership for the Consolidated Arizona Smelting Co. of Humboldt was granted in the Federal court at Tucson by Judge Sawtelle on December 24. The action culminating in the receivership was instituted by Francis S. Viele of Prescott and other creditors of the company. G. M. Colvocoresses, general manager for the company, was named by the court as receiver.

Final payment on the Stargo group of claims, 26 in number, from which shipments of silver and gold ore have been made continuously for the last 15 months to the smelters at Douglas, has been made, and the Stargo Mines, Inc., formed to receive title to the property. George J. Stoneman, president of the company, announced that about \$50,000 will be expended at once in development work in the lower levels with the expectation of justifying the erection of a 100 or 200-ton mill during 1921. This work will be carried on under the direction of William B. Ghoring, as consulting engineer, formerly superintendent of mines for the Calumet & Arizona Mining Co. of Bisbee.

Following the recent sustention of a demurrer to an injunction suit filed in Los Angeles in connection with the battle for the control of the Jerome Superior Copper Co., the plaintiffs have filed their action in the Yavapai county court. Counsel for those stockholders named as defendants in the suit, interposed the demurrer in Los Angeles on the ground that the court had no jurisdiction, as the corporation was of and in Arizona. The plaintiffs seek to bind the defendants from taking control of the corporation and of the corporation property. Officers and directors of the company are named as defendants.

KINGMAN.—Recent work done on the old Rawhide claim of Rawhide camp by Tony Hill and associates has opened rich silver ore, assays of which run 400 to 2000 oz. per ton in silver. A shipment of 140 lb. of the richest ore has been sent to the Selby smelter.

Operations, which have been suspended at the Arizona Mossback Mines Co. pending the overhauling of machinery, are to be resumed on the lower levels soon. It is reported that the company has sold half of its \$500,000 bond issue, the money from which is to be used for development and the erection of a mill.

MAYER.—Work at the Kay mine of the Kay Copper Co. was resumed on January 1; the new electric hoist has been installed. The power-line and other electrical equip-

ment is already in place. As soon as the installation of the hoist is completed sinking of the new three-compartment shaft is to be resumed.

WICKENBURG.—The Magewood Copper Mines Co. has taken over the Eva Consolidated Mining & Leasing Co.'s properties consisting of ten claims upon which there are said to be eight veins. The Magewood Copper Mines Co. is incorporated for 2,000,000 shares, 450,000 of which have been underwritten by the Standard Securities Co. of New York. Development work is to be done under the direction of Kirby Thomas of New York. About 500 ft. of development work has been done on the group and ore averaging \$26 per ton is said to have been opened. The property has been idle for some years.

COLORADO

RICH ORE DISCOVERED IN ASPEN MINES.

BRECKENRIDGE.—Ore assaying 2600 oz. silver and 70 oz. lead has been found in the June Bug lode. About one ton sacked by the lessees was shipped to obtain cash for celebrating Christmas. A shipment from the Auge lease on the Brooks-Snyder was settled for by the A. V. smelter, of Leadville, at \$700 per ton for first-grade, and \$50 per ton for second-grade ore. The Wellington Mines Co. has ceased operating its two mills, due to the low price of zinc, and is confining operations to mine development.

CENTRAL CITY.—Rich lead-carbonate ore, with silver averaging 300 oz. per ton, has been opened up on the After Dinner mine adjoining the Hard Money in the Hughesville district. The vein, struck at 50 ft., is reported widening. The operators, Hughes brothers and Swarthout, are installing machinery and plan to sink to a depth of 200 ft. Sinking is in progress at the Atlantic shaft at Hughesville, and will continue to 200 ft. Rich silver ore is saved from a vein in the shaft and in the 85-ft. level drift.

The Midwest M. & M. Co. has let a contract for a 300-ft. cross-cut tunnel starting from North Clear creek to connect with the Silent Friend shaft at 400 ft. Eight known veins, outcropping at surface, lie directly across the tunnel line. The Cyclops shaft is also to be drained to a depth of 400 ft. by the cross-cut, and with connection made an underground hoist will be installed and the Cyclops operated below the tunnel-level and ore taken to surface through the tunnel. The Midwest is also mining a good grade of ore in the Peruvia, and the Alaska mine, two miles distant, is under development. The ore

now being mined contains around 75 oz. silver and 10% lead. The ore is treated at the Iron City mill controlled by the Midwest, but a new mill will be constructed next spring in which flotation will be used.

CRIPPLE CREEK.—A gold brick weighing 102 oz., of estimated value of \$2100, was forwarded to the Denver Mint on December 15, from the mill of the Lincoln M. & R. Co., on Ironclad hill. This was the first bullion shipped. The mill is treating low-grade gold ore by the Gasche process. F. G. Gasche is manager for the company. Owen Roberts, former lessee of the El Paso Gold King, has taken a new lease on the Poverty Gulch mine, reputed the first producer of the Cripple Creek district. Twelve sets of sub-lessees started in with Roberts the first day. Roberts is also operating the Strong mine at Victor and, with a number of sub-lessees active, is shipping about 600 tons monthly of \$20 ore. Both mines are controlled by the Giddings-Lennox interests of Colorado Springs.

IDAHO SPRINGS.—The Humboldt property on Ute creek has been leased to local operators who are prospecting in one of the three tunnels on the property. Work is shortly to be started by lessees on the Columbia mine on Chicago creek. The Black Eagle on Chicago creek has been leased to Leadville operators who plan to operate the property through the Star tunnel. All three of the Idaho Springs mills are operating at capacity and report more ore delivered at their plants than for several years past.

ASPEN.—Excitement continues high over the discovery in the Hope tunnel and this has been enhanced by another important discovery in the Park tunnel. It is nearly a month since a high-grade seam was exposed in the Hope and the first assay returned 19 oz. silver. The entire breast of the tunnel is now in high-grade ore with neither wall yet determined. Late assays are reported to have shown 74 oz. silver, 29% lead, and some copper. The shoot has now been proved by a drift for 50 ft. and it shows no sign of decreasing in volume or value. Practically every railroad man running into Aspen or Leadville is interested and merchants in both Leadville and Aspen have steadily contributed to the Hope Tunnel development fund for the past twelve years and apparently their persistence is about to be rewarded. Eighteen inches of high-grade silver ore in the Jenny Lind runs as high as 180 oz. silver and the entire 2½ ft. of ore lying flat carries but little less. The orebody has been proved for a width of 35 ft. with the hanging wall not yet in sight.

LEADVILLE.—Leadville men have taken a three years lease on the Daly shaft of the Little Chief group on Fryer Hill. Sundry sections of the Pittsburgh, Little Chief, and Dives properties, included in the lease, will be developed. The lessees are experienced miners and are confident of opening a rich deposit of black iron. The triple-compartment shaft on the Daly is in need of repair and is being re-timbered and straightened. Few unpatented claims in Leadville have been neglected and the assessment work has in many cases been accom-

plished. A few old timers will, however, be benefited by the relief measure passed by Congress and signed by the President just before the first of the new year.

MICHIGAN

REVIEW FOR THE YEAR 1920

HORRITOS.—With the price of copper so low that few Lake Superior mines can make a new dollar while spending an old one, the mining companies of this district face a gloomy prospect for the new year. None of them looks for substantial improvement in the metal market until at least mid-year and it is certain that the present outlook from an operating standpoint is precarious.

The year end leaves the district with only the Calumet & Hecla, Copper Range, and Stanton groups, and the Quincy mine in operation. Only the conglomerate branch of the Calumet & Hecla proper is active, all Osceola lode shafts having been closed, and of the subsidiaries, the Ahmeek and Isle Royale are the only ones working. The Champion, Baltie, and Trimountain mines of Copper Range are producing 60% of normal, and Quincy also is on a 60% basis. Mohawk and Wolverine of the Stanton group are rapidly increasing production and will be back on a normal basis soon after the first of the year. Of the operating mines, Copper Range and Quincy are just about 'breaking even' on a 15c. copper market. Calumet & Hecla will finish the year with about 70,000,000 lb. of copper on hand. Copper Range and Quincy metal stocks are fully as large as a year ago, while Mohawk and Wolverine are cleaned up on copper, selling it about as fast as it is produced.

All companies in the district that have attempted to maintain production have been hard hit by unusual costs this year. The high price of fuel has been a big item. Coal that was purchased a few years ago and laid down at the docks here at a cost of \$3 per ton now costs \$10.50. The sharp advance in freight-rates also has hit some of the mines not owning their own railroads. As an illustration, one company is compelled to pay \$700 per day for the privilege of hauling ore to its mills, a distance of seven miles, while it pays \$100 per day for transporting coal from docks to mine. It means a big extra expense that adds materially to production costs. Calumet & Hecla and Quincy own their own railroads and are not affected by these high freight-rates, while Copper Range, which is a stockholder in the Copper Range Railroad company, which serves the Champion, Baltie, and Trimountain mines, gets some of its freight expenditure back in the form of dividends.

High costs have driven some of the smaller properties into idleness. The Franklin and Hancock have been closed for some months, and during the year Mass and Michigan also shut-down. None of the so-called Lake group of properties is doing any development work and Winona is closed. The recent curtailment policy of Calumet & Hecla also added the Osceola, Osceola lode shafts, Allouez, Centennial, La Salle, and White Pine to the list. Owing to the fact that the Calumet & Hecla curtailment

policy came late in the year, the production of the Calumet & Hecla group will not be much under the output of last year. Production will be slightly under 100,000,000 lb., while in 1919 it was 101,000,000.

Of the developing properties, Arcadian Consolidated, Seneca, and Mayflower continue in operation, with encouraging prospects of success. Particularly in Seneca and Arcadian the ground penetrated in sinking and drifting is uniformly and heavily mineralized, comparing favorably with any amygdaloid openings in the district, and a continuation of present content should put these properties in the producing class. Seneca announces a production in November of 82,451 lb. of refined copper from 2275 tons of rock taken out in course of development. This is an increase over October. The south drift is yielding splendid rock and the highly mineralized area in the north drift on the same level persists. In the third and fourth levels, north, good quality rock still is found, with the general outlook in that section uniform. In the Arcadian's New Baltic shaft, the outlook continues good. The shaft is now 800 ft. deep. A station has been cut at 719 ft., which corresponds with a depth of 750 ft. in the New Arcadian shaft. No drifting will be done on the lode, but the shaft will be sunk without a stop to a depth of 942 ft., at which point a drift will be driven to connect with the 900-ft. level of the New Arcadian shaft. This drift will be 3500 ft. long. Subsequently drifts will be extended from both shafts at points of contact with the lode. Mayflower's south raise, now 400 ft. long, is breasted in a mixture of trappy and mineralized matter. The raise in the east cross-cut, driven from the north drift, is in conglomerate formation and breasted in rock that is practically barren of copper. Four machines, operating two shifts, are at work on the two projects.

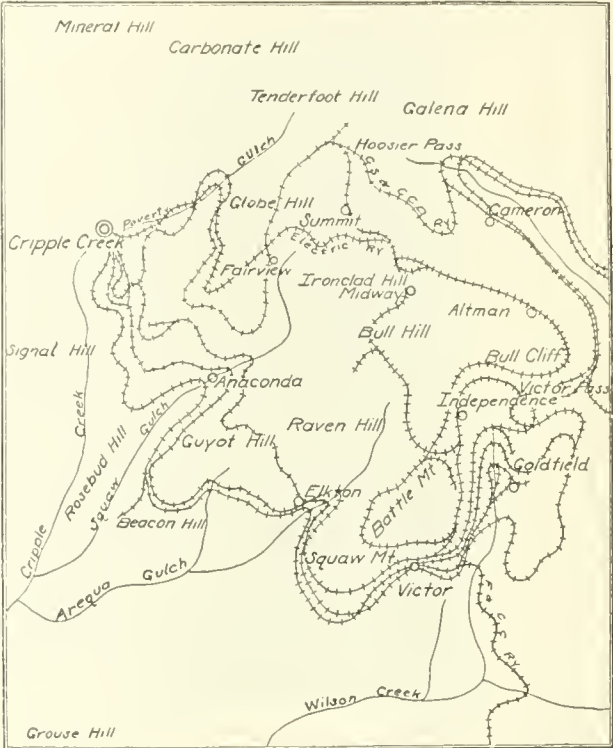
NEVADA

SUNDRY NON-METALLIC MINERALS ARE BEING MINED IN SOUTHERN NEVADA.

TULE CANYON.—Seven men are employed by the Silver Hills, which is operating the Ingalls mine under an option. It is reported that milling is to be resumed and that the search for the vein on the 200-ft. level is to be continued. Men who have been at the mine recently say that 40 ft. of drifting in a direction opposite to that in which the former work was done should result in the vein being entered.

YERINGTON.—Gypsum for use in the manufacture of portland cement is being shipped from the mines of the Ludwig Mines Co at a rate of 100 tons daily. Twenty-five men are employed by the cement company, which is developing the deposits under a lease which may be extended to ten years as a result of the large tonnage of material, containing 85 to 95% gypsum, that has been developed. The company is developing two deposits and has a plant at Mound House on the Southern Pacific railroad. The largest and most valuable deposit is said to be at Ludwig, near Yerington, where there is reported to be 1,000,000 tons exposed. The plant at Mound House may be moved to Ludwig, according to reports.

DEATH VALLEY JUNCTION.—The Pacific Coast Borax Co., due, it is said, to a reduced demand combined with increased freight-rates, has cut the working force at the mines and treatment plant. This is the first time in the years the company has been working in Death valley that an appreciable reduction in the number of men employed has been found necessary. Increased freight-rates also have greatly reduced the output of the Carrara Marble Co. at Carrara and the Continental Fluorspar Co. at Beatty, both of which have been shipping to Eastern points. Despite the difficulties of these and other companies there are many searching for non-metallie minerals everywhere in the southern part of the State, the inquiries coming principally from chemists in industries being established on the Pacific Coast. These men ap-



CRIPPLE CREEK AND VICINITY

parently enter the field in the desert region of southern California and work north as far as Goldfield. There appears to be a demand for diatomaceous earth, used as an absorbent and polisher; sodium sulphate, used in the manufacture of glass; barite, used to weight paper, and, as barium hydroxide, in refining sugar; fuller's earth, used in refining oil; and calcite in the form of chalk for fertilizer. Fuller's earth is being mined on a large scale at Shoshone and oil companies continue to buy ground there.

BONNIE CLARE.—The first earload of lead-silver ore from the Arrowhead Rico, at Ubehebe, California, has been loaded here and another earload is nearly ready. The ore is being shipped to the United States Smelting, Refining & Mining Co. under a contract made by J. C. Brumblay of the Salt Lake office of that company, who recently visited the mine. Work in the tunnel at a depth of 80 ft. has been stopped until the tunnel can be cleared

of broken material and this sacked and shipped. The ore shoot has been opened for a distance of 60 ft. and the limit has not been reached.

FALLEN.—The Silver Range Mines Co., operating in the Cox canyon part of the Silver range, east of Fallon, plans to spend \$100,000 in additional development work on the 52 claims owned by the company. Two veins are being developed, one copper-silver-gold and the other silver-lead-gold. The company has done 5000 ft. of development work and the present work consists of a tunnel that has been driven 50 ft. in ore two feet wide and assaying \$10 in silver and lead. It is reported that much low-grade ore has been opened and the company plans to erect a concentrator eventually.

ELY.—The Nevada Consolidated, following in the wake of other big copper companies, has announced a general reduction in wages, including a cut of \$1.25 for craftsmen, \$1 for other employees receiving \$5.25 or over, and 85c. for those receiving less than \$5.25. The company has been seriously affected by an order of the Interstate Commerce Commission suspending until April 29 the voluntary reduction in freight-rates on smelter products that the railroads granted. It is said that this order will make it difficult for the company to operate the smelter at a profit because of the low price for blister copper, which is the principal product.

VIRGINIA CITY.—The Virginia City Miners' union has voted on and accepted a wage-scale agreement for their part of the district practically identical with the agreement recently reached between the Gold Hill miners and operators. The agreement involves a gradual reduction in wages to \$4 on December 1, 1921. The vote is said to have been almost unanimous.

EUREKA.—At the Eureka-Croesus mine the 'shale' raise has holed through into the old workings and a drift has been started on the ore. In raise No. 8 the face of the shale is dipping flatter to the west; this is believed to indicate the near presence of ore. In No. 2 raise, along an east-west fracture leading from the north-south fissure, high-grade ore is being extracted, said to be identical with a similar body found in that locality a year ago. On three other cross-fissures, within 100 ft., the showing is promising. The company is adding to its holdings by purchasing contiguous ground. Development work is carried on through the Catlin shaft, at the southerly end of the Connolly claim at the most southerly part of the Eureka-Croesus property. A double-gear 60-hp. air-operated hoist and two Chicago pneumatic air-compressors of 356 cu. ft. have been received at the mine, but are not yet installed. The Eureka-Eclipse mine, just west of the Holly and Bullwhacker mines, north of Adams hill, is being developed. The company is sinking a shaft in quartz porphyry which assays from a trace to 80c. per ton and is the same formation in which the ore-bodies in the Holly and Bullwhacker occur. The shaft at the Eureka Holly mine is down to the 600-ft. level, where a station is being cut out. Sinking will be resumed as soon as the station is finished. The machinery for the

Holly mill has been hauled to the ground and is being installed.

At the Uncle Sam Con. mine a contract has been let to drive an additional 100 ft. in the main adit, which enters the property from the south side of New York canyon. The face of the adit is now 350 ft. from the north end of the Hamburg mine; within the last 10 ft. two stringers of ore, which look promising, were cut.

UTAH

FOREIGN CAPITALISTS ARE INVESTIGATING OIL-SHALE RESOURCES OF UTAH BASIN.

SALT LAKE CITY.—Carl A. Allen, State Inspector of Coal Mines, estimates that the coal production in Utah during 1920 was 5,818,500 tons, as compared with 4,629,722 tons for the preceding year. The record output for any one month in the history of coal mining in this State was in January 1920, when 589,668 tons was mined. Had this record been maintained throughout the year, production would have been 7,076,016 tons. Mr. Allen estimates that the maximum capacity of Utah coal mines, as at present developed, working eight hours per day for 52 weeks per year and without any interruptions, from labor shortage, strikes, lack of market, mine disability, and other causes, is about 8,760,000 tons per annum.

A representative of an English syndicate, two of a Belgian company, and two of a French syndicate, operating jointly, have been in the Uintah basin inspecting the enormous deposits of oil-shale in that locality, according to R. S. Collett, of Roosevelt, Utah, who represents local capitalists interested in the deposits, said to aggregate 40,000 acres. After spending some days in the Basin, the representatives left for New York, to present their report.

The local lead-smelting companies are being seriously affected by the decline in ore shipments, owing to the unsatisfactory condition of the metal market. At the United States smelter at Midvale, W. A. Howard, manager, reports that its heaviest shipper of high-grade lead concentrate, the Snowstorm mine at Troy, Montana, has suspended operations entirely; the Pittsburg-Idaho and the Latest Out properties at Gilmore, Idaho, have also closed, as has the Utah-Apex mine at Bingham, the largest producer of lead in Utah.

BINGHAM.—During its fiscal year ending August 31, 1920, the Utah Apex Mining Co. had gross receipts of \$1,279,562, while expenses, including cost of litigation and a charge of nearly \$100,000 for depletion and depreciation, amounted to \$1,224,277, leaving net profits of \$55,285. On that date the company had current assets of \$621,535, mostly cash and Liberty bonds, against current liabilities of \$77,501. During the year various changes were effected in the flotation department of the concentrating plant, which increased its efficiency, and considerable attention was devoted to the question of a lead-zinc separation in the mill on a commercial scale. The mine, as now developed, has a capacity of 1000 tons output per day. The Utah Consolidated company is now withdraw-

ing its equipment from the territory awarded to the Utah Apex company on October 21, 1920, by the United States District Court of Utah.

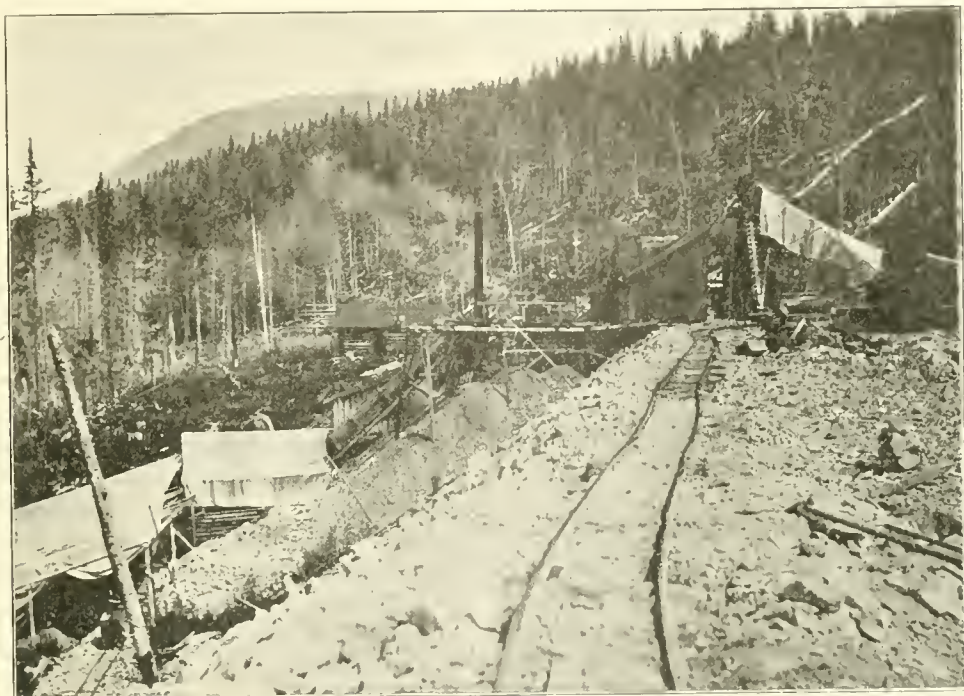
EUREKA.—The directors of the Grand Central Mining Co. have declared a dividend of one cent per share, payable January 21, which will call for the payment of \$6000. A dividend of four cents per share was paid during the first quarter of 1920, and one for three cents per share during the second quarter of the year. The total of such disbursements to date is \$1,866,000. The directors of the Gold Chain Mining Co. have also declared a dividend of one cent per share.

During the week ending December 25, the Tintic Standard shipped 50 cars of ore; Chief Consolidated, 45; Dragon, 22; Eagle & Blue Bell, 13; Iron Blossom, 13;

BRITISH COLUMBIA

PROPOSED MEASURES FOR STIMULATING GOLD MINING.

VANCOUVER.—The necessity of encouraging the production of gold in British Columbia is becoming increasingly apparent; the latest public body to take action is the Mining Bureau of the Vancouver Board of Trade which recently passed a resolution offering a number of suggestions to the Dominion and Provincial governments. One is the removal of all taxation on gold mines until "such time as conditions return to normal"; another "the return to Canada of all gold produced from exported ores and the purchase thereof by the Mint at Ottawa and the Dominion Assay Office at Vancouver"; and a third "that all gold sold by the before-mentioned



SILVER STANDARD MINE NEAR HAZELTON, B. C.

Iron King, 9; Victoria, 7; Gemini, 4; Mammoth, 2; Gold Chain, 2; Colorado, 2; Swansea, 2; Tintic Drain Tunnel, 1; making a total of 172 cars, as compared with 180 for the preceding week. The decrease in shipments is due to the fact that the Tintic Standard has been requested by Salt Lake Valley smelters to hold its production down to approximately 300 tons per day.

Walter Fitch, president of the Chief Consolidated Mining Co., returned on December 24 from Washington, D. C., where he attended the meetings before the Interstate Commerce Commission on freight-rate hearings as applying to ore shipments in this State. Mr. Fitch states that he feels confident that the Interstate Commerce Commission will uphold the action of the Utah Public Utilities Commission and that there will be no increase in the present rates on coal and ore shipments. With the decreases in prices of metals, even the largest lead and silver producers in this district are operating on a comparatively small margin.

institutions for industrial purposes should be so priced as to cover the normal cost of production, any surplus revenue to be distributed among the gold-mining companies in proportion to production".

Rumors are in circulation to the effect that negotiations are in hand having in view the transfer of the holdings of the Granby Consolidated Mining & Smelting Co., Ltd., at Anyox, including the Hidden Creek mine, and at Cassidy's, Vancouver Island, where is situated a modern coal-mining plant now in operation, to the Canadian Consolidated Mining & Smelting Co. It is stated, briefly, that engineers representing the Canadian Consolidated, a subsidiary corporation to the C. P. R., have been over the plant of the Granby company at Anyox; that the C. P. R. would find it convenient to have the output of the Cassidy Collieries available now that coal is replacing oil as fuel for its coast steamships and its British Columbia railways; and that the Canadian Consolidated has long been feeling its way toward the establishment of a

smelter on the coast. On the latter point reference is made to the company's expenditure of approximately half a million dollars in the development of the Old Sport mineral claims, on Quatsino sound, to its interest in the Sanloch Mining Co.'s properties; and to the option it has secured on the Big Interior group. All these are copper prospects and, if development proves them capable of producing the tonnage of copper-bearing ore now indicated, especially in respect of the Old Sport and the Sanloch, a smelter on the coast for the treatment of the ore will be necessary. Hence it is claimed to be not unlikely that the Canadian Consolidated Co. might consider the acquirement of the Granby company's holdings.

BARKERVILLE.—R. F. Ward states that he has bonded the Bullion mine to New York and Kansas City interests, and that a deposit of \$20,000 has been made to bind the deal. The consideration has not been divulged. This property has seen many vicissitudes. At one time it was owned by a group of Canadian Pacific railroad officials, including Messrs. Van Horne and Shaughnessy, who spent in the neighborhood of two and a half million dollars in exploration and the construction of canals, and who took about half a million dollars worth of gold from the property. Then it passed into the hands of the Guggenheims, who spent considerable sums in development. From the Guggenheims it passed to the present owners in 1913, and then became involved in legal complications, from which it was not freed until recently. During the six years of idleness much of the original construction work has fallen into decay, and, Mr. Ward estimates, fully a quarter of a million dollars will be required to put the property on a working basis.

TRAIL.—During the third week in December 9967 tons of ore was received at the smelter, 9168 tons coming from the Consolidated company's mines. The other shippers were: Canada Copper, Allenby, 161 tons; Horn Silver, Chepaka, 53; Josie, Rossland, 256; North Star, Kimberley, 190; and Paradise, Lake Windermere, 138. There is a considerable supply of all base metals on hand at the smelter, and all but absolutely necessary work has been stopped. This has caused the dismissal of a large number of men, and, as a consequence, curtailed expenses.

ONTARIO

MERGER OF THE VIPOND-NORTH THOMPSON AND NORTH CROWN IS PROPOSED.

PORCUPINE.—Negotiations are in progress looking to the merger of the Vipond-North Thompson and the North Crown Mines Co. As a preliminary step Major Bell, manager of the Vipond-North Thompson, has made an examination of the workings of the North Crown and H. J. Stewart, manager of the North Crown has investigated the records of the Vipond-North Thompson, the mine being inaccessible owing to its being full of water. A meeting will be held this week in Montreal for the purpose of arriving at a basis of amalgamation. The combined area embraced in the proposal is 320 acres. Each of the two groups has a mill with a capacity of 120

tons per day. It is estimated that important economies in operating costs can be effected by the amalgamation, as the ore in the mines involved often extends from one property into another, and one of the improvements likely to be carried out should the merger take place will be the utilization of the North Thompson shaft as a main hoisting way for the combined properties. On the Krist property of the North Crown diamond drilling almost horizontally from the 500 ft. level has passed through several important orebodies. About 250 ft. of cross cutting has been undertaken in order to reach them.

The Hollinger Consolidated by the use of auxiliary steam equipment has been able considerably to increase its tonnage, having treated as much as 2400 tons of ore in 24 hours, as compared with an average of between 1700 and 1800 tons during November.

KIRKLAND LAKE.—During November the Lake Shore treated 1810 tons of ore with a recovery of \$49,339 being an average production of \$27.25 per ton. Production during the company's fiscal year which ended November 30 was \$483,701, the average recovery being \$25.63 per ton. More than half the ore treated came from development work, otherwise a much higher average would have been reported.

Operations at the Teek-Hughes have been temporarily suspended on account of a broken hoist, which is expected to be repaired in about a week.

COBALT.—As the result of a conference between representatives of the Workmen's Central Council and the Temiskaming Mine Managers Association it has been decided to hold the proposed sick benefit scheme in abeyance. The reason assigned is that under the unfavorable and uncertain conditions now prevailing it would be unwise to start at present, as the comparatively small number of men now employed would not provide sufficient funds to fairly test the feasibility of the scheme. It was decided to postpone its operation till some future date, probably May 1.

A new company has been organized under the name of the Ruby Co-operative Cobalt Mines, Ltd., with a capitalization of \$1,500,000, to take over and operate the Ruby mine in the south-eastern part of the Bueke township. Development during the fall has met with encouraging results and a considerable quantity of good milling ore has been opened.

Much importance is attached to the deep drilling operations now being carried on at the Crown Reserve mine. The hole that is being put down to test the ground underlying the diabase in the section where the principal veins have been found is now down 1300 ft. below the surface. Officials of the Dominion Geological Survey are making a study of the geology of the mine as shown by the drill.

LARDER LAKE.—The Crown Reserve plans to carry on exploration of its claims by diamond-drilling beginning early in the year. Exploration of a belt running north from the Costello claims was undertaken during the summer but little progress was made by reason of the heavy overburden. In places where they did get through the results were encouraging.

THE MINING SUMMARY

CALIFORNIA

Calaveras County.—The new 10-stamp addition to the mill of the Carson Hill Co. has been in operation about a month, bringing the total capacity of the plant up to 500 tons of ore per day. The ore is reported to average about \$11 per ton, with total operating expenses ranging around \$4 per ton. The company is at present developing an extensive area of ground adjacent to its productive territory and steadily increasing the reserves of commercial ore. Plans for 1921 include opening new levels, exploration of new sections of the outside territory, and maintenance of capacity production.

Nevada County.—Unwatering of the inclined section of the main shaft of the Idaho-Maryland mine has reached a point where the company will soon be in a position to undertake exploration of the lower levels. In the upper levels, served by the vertical part of the shaft, lessees have opened shoots of profitable ore, but the chief interest centres on prospective discoveries in the lower workings. The mill is running on ore from leasing operations, and the shaft is being unwatered as rapidly as practicable. The enterprise is managed by the Bulkeley Wells Syndicate and ranks among the most important in the Grass Valley district.

Sierra County.—Temporary suspension of mining at the Kate Hardy property has been ordered and most of the miners have been laid off. The reason given is the inability of the company to finish its reduction plant as soon as expected and the lack of further storage space for ore. Work on the mill is being rushed as fast as weather conditions will permit. The shaft is now sunk to a depth of nearly 200 ft. At the 100-ft. level a station has been cut and a large centrifugal pump installed to handle the water. Another station is to be cut at the 200-ft. level, and drifts will be run both north and south on the vein.

COLORADO

Cripple Creek.—Gold production from the mines of the district, due to prevailing labor conditions and high operating costs for the year 1920, is the lowest since 1895, when the camp, but five years old, produced \$6,100,000. The 1920 total is reported at \$5,956,222. The production by months was as follows: January, \$609,674; February, \$511,500; March, \$605,000; April, \$473,590; May, \$442,867; June, \$494,264; July, \$614,937; August, \$477,603; September, \$426,489; October, \$425,298; November, \$450,000; and December, \$470,000.

IDAHO

Coeur d'Alene.—That the Bunker Hill & Sullivan company will erect a million-dollar electrolytic-zinc refinery at Kellogg, and that through the purchase of an interest in the Northwest Lead Co., of Seattle, it has entered into the manufacture of lead plumbing material, has been announced by Frank M. Smith, smelter director of the Bunker Hill & Sullivan company. "The company has definitely decided to go into the zinc field," said Mr. Smith. "An electrolytic-zinc plant is to be built at Kellogg to treat the Star ores, probably using this process. We are making arrangements with the owners of the Star mine that, when market conditions are favorable, the mine will be operated and the ores

treated at the Bunker Hill & Sullivan plant. The ore is a complex zinc-lead ore from which two concentrates will be made: lead, which will be treated at the smelter; and zinc, which will be handled by the proposed new electrolytic plant. The initial capacity will be 25 tons of metallic zinc per day, so arranged that the capacity can be increased to 50 tons per day when market conditions warrant. The plant will cost approximately \$1,000,000 for the first unit. We are going ahead with the plans so that they will be in readiness for use as early as next year if building costs justify. It will be two years probably before the plant is in operation. The Bunker Hill & Sullivan company has bought a substantial interest in the Northwestern Lead Co., of Seattle, a concern manufacturing lead pipe, sheet-lead, lead traps, bends, and many other lead products for the plumbing trade. This company has been operating for the last two or three years and has used the Bunker Hill & Sullivan pig-lead exclusively. Now that the Bunker Hill & Sullivan company has acquired a financial interest in the company, it is proposed to extend its market in the north-west territory."—The Morning Club, of Mullan, was recently dedicated. It is evidence of broad-minded policies on the part of the Federal Mining & Smelting Co. The expenditure of \$100,000 for the club-house and its equipment is the indirect result of prohibition, which left the miners without their usual recreation resorts. The company, which owns the Morning mine, felt that something should be done to make pleasant the leisure hours of its men. They planned the club-house, first intending it to be built at the mine. Citizens of Mullan asked the company to put the club at Mullan and the citizens of Mullan furnished the site. Everything else, including entire furnishings and equipment, was paid for by the mining company. Mullan people are given the privilege of the club.—The Idaho Mines Leasing Co. has secured good results in exploring the old Black Bear mine on Canyon creek. It has ordered a 50-ton mill which it is building and which it expects to have ready for operation by January 1. This is the Black Bear belonging to the old Frisco mine and now held by the Federal Mining & Smelting Co. The Idaho Leasing Co. has a lease on all the workings of the Black Bear above the No. 3 tunnel. A good body of lead-silver ore has been discovered which is said to be four feet wide and 200 ft. long. The lessees say they have enough ore in sight to operate their mill for three years. Bins have been built at the railroad and an 800-ft. cable tram installed from the bins to the tunnel above that will be used in bringing out the ore.—Material for the new concentrator at the Yankee Boy mine on Big creek of the Coeur d'Alene is now being delivered at the property. The Yankee Boy property was recently consolidated with the Sunshine Mining Co.'s holdings and will be operated by that company. The property has been a shipper of high-grade silver ore for a number of years, shipping a hand-sorted product, in the course of which a large tonnage of mill-ore has been accumulated. This will now be treated in the new mill, which also treats the lower-grade ore taken from the mine while extracting the richer ore.—Steady development of the Chicago-Boston mine is proceeding. In the lower tunnel at a point 420 ft. from the shaft a cross-cut has been started and run 50 ft. south-easterly. This is intended to cut into

the orebody found on the 200 ft. level. The Paragon mine in the Murray district expects to sink its shaft to an additional depth of 200 ft. The company's mill has been overhauled and is in better shape now than ever before. The additional depth will give a much better grade of ore than that which was shipped some years ago from the upper level of the property. The Giant Ledge Mining Co. will continue work throughout the winter and by spring hopes the development work will warrant completing and operating the mill which is partly constructed. From the bottom of the 400-ft. shaft the vein has been followed 900 ft., and at no point in that distance is the tunnel out of ore, although at some points its grade was not as good as at others. The vein is 35 ft. wide at the far end of the tunnel.

Soda Springs. The construction of an eight-mile branch by the Union Pacific Railroad Co. from Soda Springs to the phosphate mines of the Anaconda Copper Co. has been completed, together with the 'y's' for loading-purposes, and two locomotives are on the ground and power connections for 4000 horse-power have been made with the lines of the Utah Power & Light Co. At this property Anaconda has a working supply of phosphate ample for 100 years, according to engineering estimates, the indicated tonnage amounting to about 200,000,000, with ample phosphoric acid content. The company also has on the ground a 'mucking' machine which will handle ten tons of rock at a shovel. Plans are under way for the shipment of approximately 1000 tons of phosphate rock daily to the Washoe smelter, where it will be treated with sulphuric acid, the latter manufactured by a special process devised at the Anaconda smelter.

MONTANA

Butte.—Metal production of the Anaconda Copper Co. at present is approximately 38% of normal based on an output of 10,000,000 lb. monthly as compared with 26,000,000 lb. for the same period a year ago. The latter amount is regarded as a fair average of the capabilities of the Anaconda company. But the ore output is considerably less, as included in the metal production is the copper obtained from the treatment of accumulated tailings at the Washoe works. The company has increased the number of its lead-stacks at the Boston & Montana smelting works at Great Falls from one to three. The residue from the electrolytic zinc-plant is being treated for its lead content. Heretofore this residue was shipped to the Tooele smelter of the International company in Utah, which is controlled by Anaconda, but the increased freight-rates forced Anaconda to more economical measures. This is the first lead-smelting operation which the company has conducted in Montana. Following the announcement of the reduction in wages, John Gillie, manager of mines for the Anaconda company, said: "Under present conditions every pound of copper and zinc mined in the Butte district is produced at a loss. There has been no market for the metal and with enormous surplus of copper and zinc in the country and the low price of the metal an adjustment of operations to suit present conditions became imperative."

East Butte is hoisting around 300 tons of ore daily of a grade exceeding 5% copper. Underground sorting is done efficiently at the Pittsmont mine of the company and in consequence the management has been able to make a good showing as far as the grade of ore is concerned. Underground sorting is not employed generally in the Butte district, but is advantageously done when extra economy of operation is necessary. East Butte is employing 140 men at the mine and about 75 in its smelter, where it treats the ore from Davis-Daly, which amounts to from two to three cars daily, averaging 50 tons each.

Cooke City.—The Republic, Glengarry, and Irma mines are producing some good ore. The ore is being hauled by truck to Gardiner, where it is loaded for shipment to the East Helena smelter.

PERSONAL

The Editor invites members of the profession to send particulars of their work and appointments. The information is interesting to our readers.

Willard S. Morse is at Los Angeles.

C. Erb Wunsch, of Denver, is here.

R. L. Thane has returned from Los Angeles.

Nelson Dickerman has sailed for Japan and China.

A. H. Redford, recently at Grass Valley, has gone to New Zealand.

Oliver C. Raiston, of the U. S. Bureau of Mines, is in San Francisco.

E. A. H. Tays, recently of Sinaloa, Mexico, has moved to Nogales, Arizona.

Robert Bulman has arrived in San Francisco from Reefton, New Zealand.

Courtenay De Katb has been to Bagalusa, in Louisiana. He is now at New Orleans.

D. J. Argall, of San Diego, California, has gone to Thane, Alaska, in care of the Perseverance mine.

H. C. Goodrich, chief engineer for the Utah Copper Co., spent several days at Los Angeles recently.

L. W. Storm, of Seattle, is examining the old placer mines of Sonora, in Tuolumne county, California.

John T. Reid, mining engineer of Lovelock, Nevada, has gone to New York, expecting to return in May.

P. A. Simon, president of the Simon Silver-Lead Mines Co., at Mina, Nevada, was in San Francisco this week.

H. V. Burgard, secretary for the Mineral Metal & By-Products Co. of Denver, has returned to San Francisco.

H. G. Thiele is superintendent of the Borosolvay potash plant of the Solvay Process Co., at Borosolvay, California.

S. M. Soupcoff, mining engineer with the Utah Department of the A. S. & R. Co., is making an extended visit in the East.

T. L. Josephs, metallurgist with the U. S. Bureau of Mines at Minneapolis, has been examining coal and iron deposits in the vicinity of Cedar City, Utah.

Oscar Friendly, superintendent of the Judge properties at Park City, Utah, has returned home after a trip to St. Louis and the mining districts of Missouri and Colorado.

C. Minot Weld, Donald M. Liddell, and Paul H. Lazenby announce that they have formed a partnership for practice as consulting engineers and economists at 2 Rector street, New York City.

D. H. Bradley Jr., who was manager for the Parral Consolidated Mines Co., at Parral, Mexico, has recently been released from his commission in the Army and is in San Francisco.

E. L. Jorgensen, formerly general superintendent of re-duction with the Chile Exploration Co., at Chuquicamata, has after 15 years with the Guggenheims opened an office as consulting engineer at 150 Nassau street, New York.

W. R. Crane is now superintendent of the Bureau of Mines Experiment Station at Tuscaloosa, Alabama, with headquarters at Birmingham. Mr. Crane has been chief engineer for the War Minerals Relief Commission at Washington during the past year.

Joseph H. Brown, assistant purchasing agent for the Ray Consolidated Copper Co. at Hayden, Arizona, died on December 29. For a number of years he was general store-keeper for the Denver & Rio Grande Railroad at Salt Lake City. About 15 years ago he became purchasing agent for the Boston Consolidated Mining Co., and when that company was taken over by the Utah Copper Co. early in 1910, he went to Arizona and has been connected with the Ray Consolidated since that time.



METAL PRICES		
San Francisco, January 4		
Aluminum-dust, cents per pound	.....	65
Antimony, cents per pound	.....	9.50
Copper, electrolytic, cents per pound	.....	14.00—14.50
Lead, pig, cents per pound	.....	5—6
Platinum, pure, per ounce	.....	\$75
Platinum, 10% iridium, per ounce	.....	\$115
Quicksilver, per flask of 75 lb	.....	\$50
Spelter, cents per pound	.....	8.25
Zinc-dust, cents per pound	.....	12.50—15.00

EASTERN METAL MARKET
(By wire from New York)

January 3.—Copper is quiet and steady. Lead is more active and stronger. Zinc is quiet and higher.

SILVER

Below are given official or ticker quotations for silver in the open market as distinguished from the fixed price obtainable for metal produced, smelted, and refined exclusively within the United States. Under the terms of the Pittman Act such silver will be purchased by the United States Mint at \$1 per ounce, subject to certain small charges which vary slightly but amount to approximately three-eighths of one cent. The equivalent of dollar silver (1000 fine) in British currency is 46.65 pence per ounce (925 fine), calculated at the normal rate of exchange.

New York		London	Average week ending	
Date	cents	pence	Cents	Pence
Dec. 28	65.00	42.00	Nov. 22	76.41 49.96
" 29	66.62	43.00	" 29	73.72 48.97
" 30	65.12	41.75	Dec. 6	69.08 44.29
" 31	64.50	40.87	" 13	62.54 41.06
Jan. 1 Holiday			" 20	63.77 41.18
" 2 Sunday			" 27	63.77 41.03
" 3	65.75	41.75	Jan. 3	65.40 41.87
Monthly averages				
	1918	1919	1920	
Jan.	88.72	101.12	132.77	July 99.62 106.36 92.04
Feb.	85.79	101.12	131.27	Aug. 100.31 111.35 96.23
Mch.	88.11	101.12	125.70	Sept. 101.12 113.92 93.66
Apr.	95.35	101.12	119.56	Oct. 101.12 119.10 83.48
May	99.50	107.23	102.69	Nov. 101.12 127.57 77.73
June	99.50	110.50	90.84	Dec. 101.12 131.92 64.78

COPPER									
Prices of electrolytic in New York, in cents per pound.									
Date					Average week ending				
Dec.	28			13.00	Nov.	22			14.62
"	29			13.00	"	29			14.15
"	30			13.25	Dec.	6			13.63
"	31			13.25	"	13			14.00
Jan.	1	Holiday			"	20			13.71
"	2	Sunday			"	27			13.15
"	3			13.25	Jan.	3			13.15
Monthly averages									
	1918	1919	1920		1918	1919	1920		
Jan.	23.50	20.43	19.25	July	26.00	20.82	19.00		
Feb.	23.50	17.34	19.05	Aug.	26.00	22.51	19.00		
Mch.	23.50	15.05	18.49	Sept.	26.00	22.10	18.75		
Apr.	23.50	15.23	19.23	Oct.	26.00	21.66	16.53		
May	23.50	15.91	19.05	Nov.	26.00	20.45	14.63		
June	23.50	17.53	19.00	Dec.	26.00	18.55	13.15		

LEAD									
Lead is quoted in cents per pound, New York delivery.									
				Average week ending					
Date				Nov.					
Dec.	28		4.50	"	22				6.4
"	29		4.62	"	29				5.67
"	30		4.62	Dec.	6				5.2
"	31		4.62	"	13				5.00
Jan.	1	Holiday		"	20				4.87
"	2	Sunday		"	27				4.43
"	3		4.75	Jan.	3				4.67
Monthly averages									
	1918	1919	1920		1918	1919	1920		
Jan.	6.85	5.60	8.65	July	8.03	5.53	8.63		
Feb.	7.70	5.13	8.88	Aug.	8.05	5.78	8.03		
Mch.	7.26	5.24	9.22	Sept.	8.05	6.02	8.08		
Apr.	6.99	5.05	8.78	Oct.	8.05	6.40	7.08		
May	6.99	5.04	8.55	Nov.	8.05	6.76	6.37		
June	7.59	5.32	8.43	Dec.	6.90	7.12	4.76		

TIN							
Prices in New York, in cents per pound.							
Monthly averages							
	1918	1919	1920		1918	1919	1920
Jan.	85.13	71.50	62.74	July	93.00	70.11	49.2
Feb.	85.00	72.44	59.87	Aug.	91.33	62.20	47.6
Mch.	85.00	72.50	61.92	Sept.	80.40	55.70	44.4
Apr.	88.53	72.50	62.17	Oct.	78.82	54.82	40.4
May	100.01	72.50	54.99	Nov.	73.67	54.17	36.0
June	91.00	71.83	48.33	Dec.	71.52	54.94	...

ZINC									
Zinc is quoted as spelter, standard Western brands, New York delivery, in cents per pound.									
Date				Average week ending					
Dec.	28.		5.60	Nov.	22.		6.66		
"	29.		6.20	"	29.		6.25		
"	30.		6.20	Dec.	6.		6.14		
"	31.		6.10	"	13.		6.42		
Jan.	1	Holiday		"	20.		5.89		
"	2	Sunday		"	27.		5.56		
"	3.		6.10	Jan.	3.		6.04		
Monthly averages									
	1918	1919	1920		1918	1919	1920		
Jan.	7.78	7.44	9.56	July	8.72	7.78	8.18		
Feb.	7.97	6.71	9.15	Aug.	8.78	7.81	8.31		
Mch.	7.67	6.53	8.93	Sept.	9.58	7.57	7.84		
Apr.	7.04	6.49	8.76	Oct.	9.11	7.82	7.50		
May	7.92	6.43	8.07	Nov.	8.75	8.12	6.78		
June	7.92	6.91	7.92	Dec.	8.49	8.69	6.03		

QUICKSILVER									
The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, according to quantity. Prices, in dollars per flask of 75 pounds.									
Date						Dec.	21		50.00
Dec.	7			55.00			28		50.00
"	14			55.00		Jan.	4		50.00
Monthly averages									
	1918	1919	1920				1918	1919	1920
Jan.	128.06	103.75	89.00			July	120.00	100.00	88.00
Feb.	118.00	90.00	81.00			Aug.	120.00	103.00	85.00
Mch.	112.00	72.80	87.00			Sept.	120.00	102.60	75.00
Apr.	115.00	73.12	100.00			Oct.	120.00	86.00	71.00
May	110.00	84.80	87.00			Nov.	120.00	78.00	56.00
June	112.00	94.40	85.00			Dec.	115.00	95.00	52.50

WHOLESALE COMMODITY PRICES

Below are shown quotations as of December 15, 1920, for those commodities regularly carried in 'Commerce Monthly', together with the highest price for the fifteenth of any month since the armistice. Prices of specific commodities which were under government control are compared with the highest price recorded after the removal of control.

It should be specifically noted that the price for the nearest available date to the fifteenth of each month was not necessarily the highest price reached. For purposes of comparison, the price is also shown for January 15, 1914.

Commodity, unit		Date		Highest price for 15th of any month since armistice or since removal of government control		Price on 15th of Dec. 1920		Jan. 1914
Cattle, \$ per 100 lb.	.....	Oct. 1919	16.80	9.50	8.60			
Coal—								
Anthracite, buckwheat, \$ per ton	.....	Dec. 1920	8.00	8.00	2.25			
Anthracite, stove, \$ per ton	.....	Dec. 1920	8.00	8.00	4.00			
Bituminous, Fairmont, \$ per ton	.....	Aug. 1920	12.00	4.00	0.85			
Bituminous, Pittsburgh, \$ per ton	.....	Aug. 1920	11.00	3.75	1.30			
Copper, c. per lb.	.....	Aug. 1919	22.50	13.75	14.12 1/2			
Corn, \$ per bu.	.....	May 1920	2.15	0.72	0.62 1/2			
Cotton, c. per lb.	.....	Apr. 1920	41.50	14.75	12.88			
Hides—								
Heavy native steers, c. per lb.	.....	Aug. 1919	52		17 1/2			
Calfskins, c. per lb.	.....	Aug. 1919	100	15	21			
Hogs, \$ per 100 lb.	.....	July 1919	22.10	9.10	8.25			
Iron and Steel—								
Pig iron, \$ per ton	.....	Sept. 1920	48.50	33.00	12.50			
Steel billets, \$ per ton	.....	July 1920	65.00	45.00	20.00			
Lead, c. per lb.	.....	Mar. 1920	9.37 1/2	4.75	4.10			
Petroleum—								
Pennsylvania, \$ per bbl.	.....	Dec. 1920	6.10	6.10	2.50			
Kansas-Oklahoma, \$ per bbl.	.....	Dec. 1920	3.50	3.50	1.03			
Rubber—								
Plantation, \$ per lb.	.....	Feb. 1919	0.56	0.17 1/2	0.56			
Para, \$ per lb.	.....	Jan. 1919	0.60	0.19 1/4	0.73			
Silk, \$ per lb.	.....	Jan. 1920	16.25	6.20	3.80			
Spelter, c. per lb.	.....	Jan. 1920	9.10	5.75	5.10			
Sugar, c. per lb.	.....	May 1920	21.57	4.63	3.29			
Wheat—								
Spring, \$ per bu.	.....	May 1920	3.30	1.61 3/4	0.91 1/4			
Winter, \$ per bu.	.....	May 1920	3.06	2.00	0.96 1/2			
Wool—								
Ohio fine delaine, \$ per lb.	.....	Apr. 1920	2.35	1.12	0.56			
Ohio 3/4 blood, \$ per lb.	.....	Aug. 1919	1.20	0.45	0.39			

MONEY AND EXCHANGE		
Foreign quotations on January 4 are as follows:		
Sterling, dollars:	Cable	3.56 3/4
	Demand	3.57 1/4
Francs, cents:	Cable	5.86
	Demand	5.88
Lire, cents:		3.45
Marks, cents		1.41

Eastern Metal Market

New York, December 29, 1920.

The year draws to a close with the demand for all metals almost nothing and with prices practically readjusted to pre-war levels. They are also at the lowest levels for the year, the declines having come in the last three months.

There is almost no buying of copper and prices are a little lower.

Consumers and dealers remain absent from the tin market and quotations are nominal.

Only a very moderate demand exists for lead and prices are a little easier.

The zinc market is lower because of weakness in London. Antimony has declined.

IRON AND STEEL

In taking account of conditions as the new year comes in, the iron and steel trade sees no prospect of a buying spurt for some weeks. The flood of shipments from mills of accumulated and current output following the release of cars restricted up to that time to carrying coal, has placed in large consumers' yards somewhat more material than they were able to dispose of, especially with the curtailment in general demand.

The last week of the year is marked by production at full blast by the Steel Corporation and by total idleness of some independent plants and for others rates varying up to perhaps 55%, or an average of about 25% for the independents and not much over 54% for all the mills. Revision of steel contracts to the basis of March 1919 has not prevented suspensions, and in the case of the Steel Corporation the successive suspensions since August have been released only in a small measure, and it seems clear that the leading producer has now less than six months orders, particularly in view of its present high scale of operations.

COPPER

What little business is reported is for small lots for prompt delivery and this is being taken largely by small interests at concessions or by those needing cash. The volume is negligible and it may be said that the market is stagnant. Quotations, largely nominal, are 13.25 to 13.50c., New York, for electrolytic copper for prompt and early delivery, with 13.50 and 13.75c. asked for first quarter. Large producers either have no price or ask 14c. for prompt and future. Production is being curtailed, but to what extent is mere conjecture.

A study of recent statistics shows surprising imports of refined and old copper. To November 1, 1920, receipts of refined copper have been 98,745,714 lb., against 35,138,760 lb. in all of 1919. Of old copper, classed as 'old and clippings', the imports for the first 10 months of 1920 were 9,742,907 lb. or at a monthly rate three-fold greater than in 1919 and 50% heavier than in 1913. Even old brass receipts are very heavy, having been 34,864,700 lb. to November 1, 1920, or three times what they were in all of 1919 and nearly four times the 1913 imports.

TIN

There is little life to the market and quotations are largely nominal. Consumers, dealers, and even speculators show no interest and until they do no betterment is possible. There are expressions to the effect that an active tin market will be witnessed early in 1921, but this will depend on the attitude of consumers, the market at present being stagnant. It is in fact so lifeless that a measure of values is difficult. The week has brought forth almost no sales, the only one reported having been 50 tons of January shipment Straits, sold on the New York Metal Exchange on December 23 at

32 75c. Spot Straits tin, New York, was quoted yesterday at 33 50c. nominal. The London market, closed Monday and Friday, was low yesterday at £200 per ton for spot standard, £205 15s. for future standard, and £205 for spot Straits. Arrivals thus far this month have been 2420 tons, of which 180 tons is credited to Pacific ports with 1890 tons reported afloat.

LEAD

Some sellers are of the opinion that the bottom of the market has been reached this time at 4.50c., St. Louis, for outside market, and 4.75c., St. Louis, for the leading interest. There are a few sellers who sold on the decline and are not as eager for new business and there are others who do not want to compete at present levels, with the result that there are less sellers than a week or so ago. This makes for a steadier stronger market tone. A little more interest is reported in small lots of one to three carloads, but actual business is small. We quote the outside market at 4.45 to 4.55c., St. Louis and New York, the latter being influenced by possible or actual imports.

ZINC

The London position is the dominating factor in the American market. New levels for the year have been made in London, where prime Western has fallen under £24 per ton, against £50 some months ago. While the British market was £1 higher yesterday than last week, already sales of about 2000 tons have been made for importation into this country in January and February at around 5.40c., seaboard, duty paid. This tendency had lowered the American market to 5.50c., St. Louis, on Monday and to 5.60c. yesterday, with the New York price for imported metal at practically the same figure, 5.65c., New York. Domestic metal for delivery in the East is around 6.10c. All quotations are for prompt delivery, producers not being willing to sell futures and selling only for immediate requirements.

It is authoritatively estimated that Belgian zinc cannot be produced under £40 per ton, while German zinc can be made around 1 to 1.50c. per pound, but in limited quantities for export. This is taken to indicate a good future for American zinc.

ANTIMONY

Wholesale lots for early delivery are obtainable at 5.25c., New York, duty paid. There is no demand.

ALUMINUM

Virgin metal, 98 to 99% pure, is obtainable from independent sellers at 22 to 23c. per pound, New York, while the quotation of the leading interest is 28.30c. f.o.b. producer's plant for 15-ton lots for early delivery.

ORES

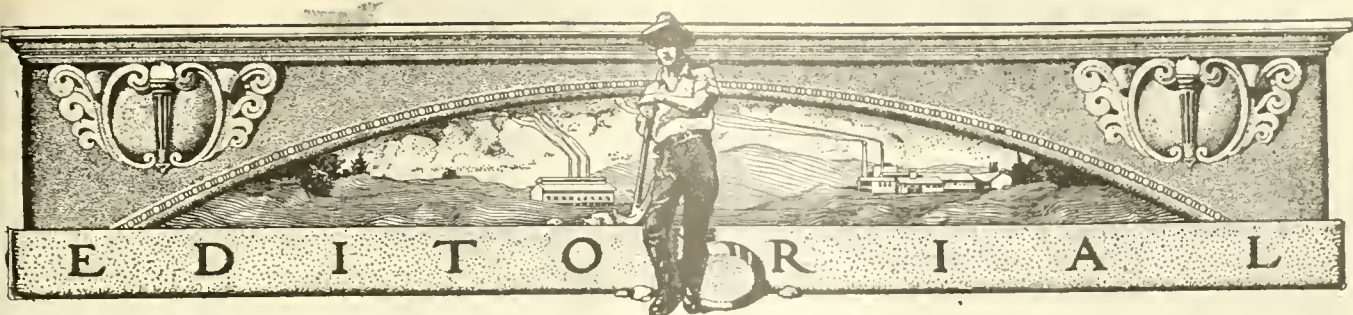
Tungsten: There has been a light business in small lots. Predominant in the minds of the trade is the tariff bill and the effect on the tungsten industry. As low as \$3.50 per unit could now probably be done on low-grade ore, with other grades proportionately higher.

Ferro-tungsten can be obtained as low as 59c. per pound of contained tungsten.

Molybdenum: The market is devoid of feature or interest. No test of values is reported.

Manganese: No business has developed and prices for high-grade ore are nominal at 35 to 40c. per unit, seaboard.

Manganese-Iron Alloys: British ferro-manganese from at least one producer can be obtained at low as \$110, seaboard, on a firm offer. American makers will probably meet any British price when business is offered. At present demand is almost nil. Spiegeleisen can be obtained as low as \$45, furnace, and perhaps lower. A sale of 200 tons is noted.



T. A. RICKARD. . . . Editor

WE have received an interesting letter, postmarked Paxton, California, on the Eilers v. Guggenheim affair, but, unfortunately, it is anonymous, and therefore cannot be published. If the gentleman will disclose his identity, not necessarily for publication, but for the Editor's information, his letter will be published.

QUESTIONS continue to come to us asking whether a locator must make a declaration or take any other steps in order to avail himself of the extension of time for doing assessment work on a mining claim. As we understand the recent enactment of Congress, he need not do so; if he does his \$100 worth of work before July 1 his rights will be maintained as if the work had been done before December 31, 1920.

C. W. Barron of the 'Boston News Bureau' has a good deal to say on current events and most of it is to the point. He has a way of speaking plainly that we like, because it saves time and thinking. Our present ills, he says, are due to the fact that "it was deemed patriotic, good politics, and good business to double wages to produce for the War. It is now seen as bad business, bad politics, and most unpatriotic." The luxurious wages have destroyed thrift as well as efficiency. We camouflaged the wage-profiters who did a third of a shift for \$10 by calling them our base-line of defence. Retail prices were advanced, by the greed of the middlemen, until the workers with doubled wages were no better off than before. Now comes the reckoning: the bromo-seltzer after the jag! It remains for us as a nation to devise simpler forms of taxation, to curtail the expense of government, to unshackle enterprise, and to cultivate habits of thrift.

ZINC OXIDE is being made from sulphide concentrate in a single furnace-operation at the plant of the Metals Extraction Company at Joplin. Mr. Charles E. Schwarz, manager of the plant, developed the process, which consists essentially in burning a mixture of unroasted concentrate and pulverized coal under a strong forced draft, the sulphur in the ore supplying part of the fuel to promote combustion. The entire cycle of treatment requires but 45 minutes, and is conducted alternately in each of a pair of twin furnaces, the oxide being collected in a bag-house in the usual way. De-

tailed technical information as to the construction of the furnaces, the fineness of the concentrate and fuel, the proportions used, the extraction obtained, and the purity of the resulting product are not at hand, but sufficient success has been attained to warrant thorough investigation by representatives of large companies with the expectation of making use of the process. There is a long stride between metallurgical accomplishment and the successful application of the scheme on a commercial basis with resultant economy in the production of a satisfactory grade of zinc oxide, but apparently progress has been made.

IN this issue we publish a description of the Greenawalt machine by the brother of the inventor, Mr. John E. Greenawalt. Mechanical furnaces for desulphurizing concentrates or other fine mill-products and at the same time producing a 'cinder' suitable for treatment in the blast-furnace have made notable progress in recent years. The Dwight-Lloyd machine, for example, forms a prominent feature of the new Bunker Hill smelter and details of the construction and operation of this well-known sintering furnace were given in the article appearing in our last issue. The Greenawalt machine is not as well known, but is being used on a large scale, notably by the Bethlehem Steel Company, at Lebanon, Pennsylvania, where one 1000-ton machine is in operation and a second will soon be ready to start, taking the place of several nodulizing furnaces. At Duquesne, also in Pennsylvania, the U. S. Steel Corporation is erecting a second Greenawalt unit of 1000 tons, for the purpose of treating the current product of flue-dust. We are informed, by Mr. William E. Greenawalt, that the wider use of his brother's invention has been delayed by patent litigation. The novel idea is said to be the porous or permeable bed of non-sinterable material underlying the charge; this preserves the grate and simplifies the discharge of the sinter. We understand that the litigation with the owners of the Dwight-Lloyd patents has been adjusted satisfactorily to all concerned.

MOST of us like to give both sides a chance. That is why we publish an article in defence of Minerals Separation. It consists of portions of a speech delivered by Mr. Alfred A. Cook, counsel for Minerals Separation, in Denver before the Flotation Conference of the American Mining Congress. We give about half of the speech

as sent to us by Mr. Cook himself, regretting that the exigencies of space prevent us from giving it all. His opponents, Messrs. Nye and Montague, had the advantage of him, in that their statements were prepared and written, whereas his was impromptu and delivered as a speech; therefore it is diffuse and repetitive, as oral utterances usually are, but it has a pleasant naturalness and a personal touch that a written statement lacks. In selecting extracts for publication, we have used our own judgment, giving our readers those that seemed best to express the speaker's ideas—that is, we have selected what we think he would have wished to be published, if compelled to apply the Procrustean method. Our readers will be interested in the speech; they have read our own attacks often and they will have wondered if there were any defence and what the nature of it might be. We are glad to give them Mr. Cook's speech, knowing him to be a shrewd and courteous antagonist.

ON January 1 the Engineering Council, formed in 1917, was formally merged in the American Engineering Council of the Federated American Engineering Societies, of which Mr. H. C. Hoover is president. The four vice-presidents are Messrs. Calvert Townley, William E. Rolfe, Dexter S. Kimball, and J. Parke Channing. To Mr. Channing the Engineering Council is largely indebted for its success, and it is the good work that it has done that has led to the formation of the larger and more comprehensive organization. It is announced in New York that "the new council will enter immediately upon a campaign of public service and will co-operate with chambers of commerce, labor organizations, and other bodies in an effort to solve pressing social, industrial, and political problems". Efficiency and economy in government is one of these important subjects, and more particularly the reorganization of the Department of the Interior as a National Department of Public Works. Mr. Channing has made public a letter received by him from President-elect Harding stating his entire approval of the plan for "bringing together under one department all the present agencies of public works now scattered around Washington". The governmental activities of the Council will be in charge of a Committee on Public Affairs, of which Mr. Channing is chairman. The Council, "whose sole idea", says Mr. Hoover, "is public service", represents nearly a hundred engineering societies, comprising more than 150,000 members. It is under excellent leadership and should do good work for the profession and the nation.

The Vanderlip Concession

If Mr. Washington Baker Vanderlip wanted notoriety, he has obtained lots of it since his return from Russia; indeed if fame be, as has been said, "getting one's name mis-spelled in the newspapers", he is even famous, for he has been called by the press Washington D. and even Frank A. Vanderlip. A nice question arises: he is described as a "well known" and "prominent" American mining engineer, and yet he is not a member of the

American Institute of Mining and Metallurgical Engineers, which is the national organization of our profession. Of course, one can be a mining engineer, even "well known" and "prominent", and yet not be a member of the Institute, but such a condition of affairs is exceptional. Sometimes an engineer quarrels with the powers that be; a paper of his is declined by the secretary of the Institute or whoever is responsible; he may have suffered some slight, real or fancied; he may dislike somebody prominent in the organization; indeed, there is ample opportunity for the play of pique or prejudice, reasonable or unreasonable, so that there are today, as always, a few engineers conspicuous by their detachment from the national organization. But they are few, and most of them are what we call 'cranks'; therefore if a mining engineer is not a member of the Institute, it is fair to say that he is not in good standing as an "American mining engineer", just as a lawyer is not in good standing if he be not a member of the Bar Association. On the face of it, that is Mr. Vanderlip's status; but in so far as he has done the work of mining engineering, notably the examining of mines and mining districts, he cannot be denied the appellation of "mining engineer". If one were to be meticulous, apropos of the Russian concession, one might prefer to call him a 'mining man', a term that covers all those engaged in making money out of mining. It is not necessary to be a mining engineer in order to do that, effectively and honorably. Our multifarious industry makes a call upon an extraordinary variety of skill, character, and experience. Mr. Vanderlip has shown unquestionable abilities of a certain, and useful, kind. He obtained what he wanted, and under conditions calling for the exercise of initiative and ingenuity of no common order. In his interview with the 'Los Angeles Times' of December 19 he gives more information concerning the Bolshevik government than Mr. H. G. Wells did in his series of articles in the 'New York Times'. Certainly he had a longer contact with Nicolai Lenin and is able to tell us more about him and his aims than the celebrated English writer. According to Mr. Vanderlip, it is acknowledged by Lenin that communism has proved a tragic and costly failure. He (Vanderlip) claims that on the concession granted to him in Eastern Siberia, no soviet or communist laws are to apply, and he is free to employ any kind of labor he pleases. One wonders what is Lenin's purpose. Is it to embroil the United States with Japan? Is it to cause the British government to hasten recognition of the *de facto* government of Russia? Here it is interesting to note that an English court has decided that the ownership of loot does not pass to the present possessor. In 1918 the Soviet government confiscated some timber belonging to a Russian firm, and in August last the Soviet's commercial agent, Krasin, contracted for the sale of this timber to an English firm. As soon as a part of it arrived in England, the Russian owners brought suit in the English courts to establish their claim to the property, and the Court decided in their favor. As the 'Weekly Review', from which we get these facts, says, the main object of

the Krasin mission and of Bolshevik agitation for the resumption of trade is to obtain recognition of the Soviet government, thereby legalizing seizures and confiscations, and the means adopted to realize on them. Perhaps the concession to Mr. Vanderlip is meant to serve the same purpose; in any event, according to his own story, the idea is to promote a resumption of trade between the United States and Russia, and that is laudable enough, if it can be done to mutual advantage, which is the essence of all good business. Whether Messrs. Lenin and Vanderlip can give adequate assurance for the safety of business under existing conditions, is then the vital question. It remains to note the fact that even Russian gold in the form of bullion has no legal value in the United States, because our Government refuses to buy or convert any gold of Soviet origin, the reason being, as stated by Mr. Raymond T. Baker, the Director of the Mint, that its ownership is under a cloud. Agents of the Soviet government and others have been endeavoring to obtain an assurance that the ban will be lifted, but without success. The Treasury Department is standing firmly on its decision. It would appear as if the same embargo would apply to other Russian exports and that Mr. Vanderlip's concession may prove a barren coup. We have no wish that it may; on the contrary, we would like to see a resumption of trade with Russia, and more particularly the mining regions of Siberia. Perhaps the incoming administration of the new President may be able to arrange matters to that end. We have no quarrel with the Russian people, even if we consider Lenin and his friends as pirates *in excelsis*.

Power Projects

Mine operators in sundry districts in Arizona, Utah, Colorado, and Nevada, the executives of railroad companies, and others engaged in industries requiring an economical source of power will be keenly interested in the projects now under way to utilize the immense reservoir of potential energy available in the Colorado river. With its tributaries this river forms one of the largest of our drainage systems, for, according to the estimate of conservative engineers, there is available for development some 3,000,000 horse-power, equal to more than one-third the total hydro-electric power generated in the United States today. We have windmills that serve a useful purpose; a motor actuated by ocean waves has been made, though a practical device has not been perfected; and there is a reasonable chance that the tide may some day be harnessed so as to translate its energy into mechanical form suitable for running railroads and industrial plants; but at the present time there are only two important primary sources of energy, namely, that of fuel, including gas, coal, and oil, and that of falling water as developed from rivers and torrential streams. Only about 12% of the available water-power in the Western States has been exploited. The stimulation of effort in this direction was the principal purpose for the establishment about a year ago of the Federal Power Commission, which is composed of the Secretary of the

Interior and the Secretaries of War and of Agriculture. This board has recently accepted the application of the Southern California Edison Company for a permit to exploit a number of the possible water-power projects on the Colorado river, principally in Arizona. This acceptance need not be followed necessarily by the issuance of the permit; it merely establishes priority on behalf of the Edison company for a limited time, so that competing corporations cannot interfere or take advantage of the costly preliminary work that the Edison company plans to perform. The company owns a number of hydro-electric and steam plants for generating electric power and has an extensive system of distributing mains centring around Los Angeles. It is presumed to be affiliated with the Electric Bond & Share Company, a huge holding corporation in New York, with practically unlimited financial backing. It is proposed first to undertake the development of some 410,000 horse-power in Marble canyon, extending for a distance of 60 miles just below the Utah-Arizona state-line and immediately above the Grand Canyon. Here a fall of 550 ft. can be utilized to develop 410,000 brake horse-power following the construction of three dams and appropriate storage reservoirs, according to the estimates of Mr. E. C. La Rue, who made an investigation of various phases of the utilization of the waters of the river for the U. S. Geological Survey in 1916. The flow of the Colorado is peculiar; the normal minimum in Marble canyon is 3500 second-feet, while the maximum is perhaps not less than 200,000 during flood-time. To obtain the maximum amount of power it would be necessary to control this flow by storage of the water so as to permit a steady average of about 10,000 second-feet. The construction of the necessary dams is a huge undertaking, requiring a large investment; indeed, the initial cost of a hydro-electric plant and the interest on the capital constitute the chief items of expense, for the costs of operation and maintenance are comparatively small. The problem of financing the Colorado River project is affected favorably by the possibilities of reclaiming additional areas of arid land by means of irrigation. The low minimum flow seriously limits the amount of land that is now being supplied in the Imperial Valley region and in Arizona under the Laguna canal, and accordingly the plan to regulate the flow doubtless will be favorably regarded by farmers in the lower portions of California and Arizona as well as by those owners of land farther up the river who will benefit by the construction of new dams in their vicinity. The income derived from the distribution of water for irrigation manifestly lightens the burden on the users of power, and, as the area of excellent irrigable land is far in excess of the 3,000,000 acres that can be supplied, the field is an attractive one for the power companies, from that point of view. A highly important consideration affecting the success of further projects is the policy to be pursued by the railroads in the electrification of their lines. There are seven important railroads whose lines traverse the territory that may be served by power generated from the Colorado. The Chicago, Milwaukee &

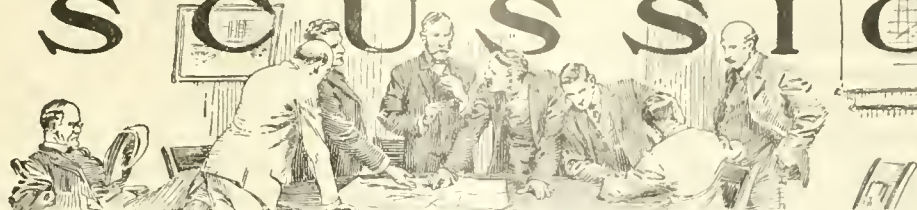
St. Paul has demonstrated to its entire satisfaction, we understand, the technical efficiency of electric locomotives when operating on the mountain divisions of its transcontinental line. From the standpoint of national economies there is nothing more inconsistent than to travel up a mountain valley behind a straining locomotive that is burning tons of precious coal or oil, while at the same time one can look down at a rushing mountain stream that, day and night, is wasting the energy that might easily be employed to pull the train. A dam, a water-wheel, an electric generator, and a system of copper wires are all that is needed to utilize the water and conserve our fuel. For years the Government has talked, and considered, and vacillated, but at last there is reason to believe that a method has been provided whereby the companies engaged in the power business can exploit our hydro-electric resources with some assurance of reasonable and sympathetic governmental protection. The Colorado is among the largest, but it is only one of many streams that may be utilized in a similar way.

'The Cost of Mining'

Elsewhere in this issue we publish a review of the new edition of Mr. James R. Finlay's book on 'The Cost of Mining'. This is one of the notable contributions to the technology of mining; with Mr. H. C. Hoover's 'Principles of Mining' it ranks as the most important contribution to the subject from members of the American mining profession; indeed, the fact that these two books were written by engineers of wide experience and high reputation is one of the reasons for their general acceptance as authoritative treatises. It may be ungracious to say so, but both books would have gained by more careful revision and closer editing, such, for example, as Dr. Raymond could have given to them. Unfortunately while modern books gain in timeliness and freshness by being written quickly and printed promptly, without the deliberation and delay usual in days gone-by when a disquisition on a progressive science or a growing industry was largely out-of-date by the time it saw the light, yet it is a pity that so many books nowadays are issued in such a hurry as to render careful revision and editing impracticable. Presumably most men prefer a book that lacks finish but is timely to one that is finished but belated; somewhere between the extremes, however, it is possible to obtain a satisfactory compromise. We make the criticism with the idea of being helpful, not of belittling the two books mentioned, which it seems to us were and are of such persistent value that they deserved more care in preparation and in printing than has been given to them. The third edition of 'The Cost of Mining' has been enriched by the addition of matter dealing with the broader aspects of the economics of mining, reflecting the author's maturer outlook. Mr. Finlay has had an experience fitting him exceptionally for the writing of such a treatise. We remember when he wrote his first contribution on the subject, in 1903, while superintendent of the Portland mine, at Cripple Creek. It was a letter on local conditions, in the course of which he

stressed the point that it was the profit, not the cost, that was the decisive factor in mining operations. That letter caught the appreciative attention of the present writer, at that time the editor of the publication to which Mr. Finlay addressed himself, and elicited a prompt response inviting him to write further on the subject. Mr. Finlay is an engineer possessing the useful faculty of mental concentration; he is able to apply himself intently on a given subject, as he has proved on several occasions since then, for instance, in his report upon the taxation of the Michigan copper mines and in his various later papers on mine valuation. In the course of his career he has examined many of the most important mines of the West; for example, the United Verde Extension, concerning which, and its geology, he gives, in this edition of his book, much information illustrating the proper method of mine appraisal. It is this foundation of professional practice that gives strength to his writing on the economics of mining; the personal contact with actualities renders his statements convincing to his readers. American technology has gained greatly by recruiting its authors from the ranks of the active profession, instead of being dependent, as was and is still the custom in Europe, upon the academic writings of indoor students of the subject. The engineer who has been outdoors, in the most expansive meaning of the word, in mining regions scattered all over the world, involving diverse economic conditions, is the one fitted to give to his juniors, and even to his contemporaries, the vital fruitifying information upon which technical progress depends. 'Modern Copper Smelting', by the late Edward Peters was a pioneer in this departure. Spurr's 'Geology Applied to Mining' was another example of field experience becoming joined to literary expression. But the economics of mining, the art of making money by exploiting deposits of ore, remained on the academic shelf until first Mr. Finlay and then Mr. Hoover used the spare hours of a busy professional career to set down on paper the findings of men in whom a technical training was joined to the examination, appraisal, and management of large mines operating under conditions sufficiently diverse to prevent the production of unfounded generalizations. The members of the American mining profession ought to be able to do much more in this direction. For a long time they were inarticulate; twenty years ago the standard books on mining and metallurgy were mostly the product of English writers, for example Le Neve Foster on 'Stone and Ore Mining', Henry Louis on 'Stamp-Milling', Rose on 'Gold', Roberts-Austen on 'Introduction to Metallurgy', Collins on 'Silver and Lead', Brough's 'Surveying'. Since then the technology of mining has been greatly enriched by American writers, particularly in the field of economic geology, in which Lindgren's 'Mineral Deposits' leads a long list of valuable books. The point we wish to make is that the American practitioner, not the savant, the professor, or the professional writer, has become articulate and thereby produced treatises more timely and more useful than any published previously.

DISCUSSION



Washington B. Vanderlip

The Editor:

Sir—Mr. Vanderlip, to whom you jocosely refer in your editorial note on page 859, has recently attracted world-wide attention, even as did the star *Novae Aquilae*, which burst into blazing glory some months ago. This sudden prominence is due to his obtaining a concession for Kamchatka and north-eastern Siberia, an area of 400,000 square miles.

As the public knows so little about him, and as you have mentioned him in your columns, it seems worth while to give a little authentic information. In the first place, his name is Washington B. (not D.) Vanderlip. Those who wish to know more of him should read his book, 'In Search of a Siberian Klondike', published by the Century Company in 1903. The frontispiece gives a picture of him that I took in 1900 at Indian Point, on Bering Sea. At that time we were fellow-passengers on the steamer 'Progress', which, under my charge, made a voyage from Vladivostok to East Cape, thence to Gejiga, at the head of the Okhotsk Sea and back to Vladivostok. We left Vladivostok in May and returned in October; since then I have met Mr. Vanderlip in New York, where he had an office for a time, being engaged in mining ventures; I have also met him in San Francisco and Tonopah. From these meetings I learned that he was busy looking for mines and devising inventions of many varieties; one improvement on a concentrator, I understand, proved profitable to him.

Mr. Vanderlip is an active man, perhaps a little below average height; he is of excellent physique, a fast runner, a good horseman, a good shot; he is bold, enterprising, and inured to hardship. He has that excellent power of making capitalists see things as he sees them; this was shown by his being able to interest London capitalists in financing the Gejiga expedition and has been more strikingly shown in his dealings with Lenin. He has a considerable knowledge of mining and is specially well-informed about north-eastern Siberia and Kamchatka.

Not much is known about the mineral resources of the concession. Gold is found in Kamchatka, and along the shores of Bering Sea, but whether there are valuable deposits has not been revealed. Excellent steam-coal exists within a few yards of the sea at Ugolnoi Bay. The most tangible and immediately available wealth is the fisheries. Salmon run up every river in incredible numbers.

Just what sort of a title Lenin can give to a concession in a region where his authority is not recognized is a puzzle; but if the capitalists who are back of Mr. Vander-

lip will continue to support him they have a fighting chance of making a profit.

The concession, if finally found valid, should naturally come under the consortium that has been entered into recently by Great Britain, Japan, the United States, and other powers.

W. H. SHOCKLEY.

Palo, Alto, December 23, 1920.

The Broad Lode Hypothesis

The Editor:

Sir—The reading of the excellent editorial on this subject in your issue of January 8 impelled me to re-read the comment, presumably written by the editor, Mr. J. E. Spurr, in the 'Engineering and Mining Journal' of November 18, in which he takes exception in no undecided way to the definition of a lode or vein as advocated by the geologists testifying for the Utah Consolidated company in the recent litigation with the Utah Apex company at Bingham, namely: "mineralized rock or rocks which contain such indications of valuable minerals as to justify development with the expectation of finding ore. As soon as quartzite over a considerable distance becomes mineralized it becomes a lode. Just as soon as either of the rocks can produce and do produce ore, or contain indications which lead the experienced miner or prospector of judgment to develop it with the expectation of finding ore, then it becomes a lode." In his criticism Mr. Spurr uses his editorial prerogative—he has almost appropriated poetic license—to exaggerate in order to emphasize his exceptions. You agree that the definition is "so inclusive as to be unreasonable" and that it would be ridiculous were it not for the seriousness of the litigation that centred about it. An effort to construct an unassailable definition of anything is hazardous; in this instance it is particularly so because of the conflict of ideas between miners, geologists, and the courts, each of which contemplates a lode from a somewhat different point of view. However, the attempt is interesting even if futile, and I shall suggest sundry modifications whereby the definition quoted can be altered so as to avoid some of the criticism launched against it, and at the same time reconcile diverging views of the judge, the scientist, and the miner himself. The courts, following the intent of the mining statute, regarded 'ledge', 'lode', and 'vein' as being synonymous and interchangeable terms. The practical miner, however, drew an arbitrary distinction to the effect that a narrow vein was a 'vein', while a wide vein was a 'lode'; fre-

quently his lode was comprised of more than one vein. This, of course, was neither precise nor scientific.

Geologists consider the genetic and structural features of a deposit in framing their definitions, but unanimity is lacking even among them. However, the term 'lode' has been accepted extensively as a more comprehensive term applying to ore deposits that cannot consistently be described as veins. As a matter of distinction the courts have frequently classified such deposits as 'broad lodes'. The courts have held that a broad lode need not have determinable walls. In the *Bunker Hill v. Empire State* suit it was decreed that in the absence of defined walls "the legal width is determined by the lines beyond which indications sufficient to encourage its further exploitation with the *hope* [italics mine] of profit, do not appear". The word "hope" should not be overlooked. This I believe you have done, in effect, in your editorial where you say "it does not become a 'lode' unless the mineralization is synonymous with ore; in other words, the mineralization must have been so intense as to result in a concentration of economic value, that is, one yielding a profit to the miner". I am sure you will agree that thousands of deposits, indisputably classed as lodes, have been mined for years at a continual financial loss, simply because of the hope that a shoot might be found that would recoup the owners for all of their losses. Sometimes the ore has been found, but quite as often the mine has been allowed to fill with water. Shall we say there was no lode where abandonment has resulted? Somewhere between the presence of mere mineralization (in which term, we allude, of course, to those minerals that, if found in sufficiently concentrated form, can be profitably marketed) and the presence of assured ore, there must be a point at which there is just enough mineral present to warrant the miner to continue his digging. Then he is 'on the lode', but not necessarily 'in ore'.

There is, however, another essential condition; it is that there be something to follow; there must be some distinctive characteristic in the constitution of the lode that indicates the direction in which mining ought to proceed. With the vein or lode, in its more restricted sense, the vein-matter is of a different composition and is distinguishable from the country-rock, and, except for pinching and faulting, may be followed continuously. If satisfactory indications of ore are found in one place, there is reasonable expectation of getting ore by following the vein. A bedded deposit often presents a different problem. In the *Richmond-Eureka* suit, to which you allude, the court declared in reference to the limestone bed under dispute: "Examining the features of the zone which separate and distinguish it from the surrounding country, we experience little difficulty in determining its character. . . . The broken, crushed, and fissured condition of the limestone gives it a specific individual character by which it may be identified and separated from all other limestone in the vicinity." Mineral was found in small fissures throughout this bed of limestone; when the miner found ore at one point he had a reasonable

hope of finding it by advancing in this distinctive and, broadly speaking, homogeneous bed. There was every evidence that the mineralization throughout the stratum was from the same source, that the ore deposits were genetically identical. The idea of sameness, of oneness, is an essential element in the definition of a lode and it is in this respect that the Utah Consolidated definition loses validity, and lays itself open to the pleasantries of editorial comment. Of course, the second sentence in the definition taken by itself cannot stand because "mineralized" requires further qualification; the degree of mineralization is the vital part. I suggest then the following definition: "A lode is a zone or belt of mineralized rock or rocks in place, uniformly characterized by qualities that distinguish it from surrounding masses of rock; deriving its mineralization throughout from the same source or sources; and sufficiently mineralized to warrant mining operations with reasonable expectation of finding ore."

This definition I submit with the hope that it may elicit interesting criticism; also with every expectation of having it torn to pieces by the readers of the 'Press' should you see fit to publish it.

A. G. OLOGIST.

San Francisco, January 8.

Mr. Hoover and Single-Jacking

The Editor:

Sir—On reading Mr. West's letter in your issue of December 18 I thought it might be interesting to him, and possibly others, to know that we were single-jacking in Western Australia before the advent of Mr. Hoover. I single-jacked while working for wages at Bullin Bullen, 16 miles from Coolgardie, in the year 1895 for E. R. Clifford on some properties he had bonded there from a Mr. Hurly. I single-jacked when working on wages for the Lady Shenton company at Menzies on their Florence property in the year 1896. C. H. Beaumont was superintendent and a Mr. Frye was foreman. I also single-jacked on the Florence O. Driscoll estate at Menzies in the same year. A Mr. James was superintendent and Alf. Parker was foreman. Also single-jacked at Niagara and other places in W. A. nearly 10 years previous to this. I single-jacked in the Barrier Broken Hill country about 2½ miles from the Proprietary mine out near Round Hill at a mine called the Potosi owned by Pell and McCabe of Broken Hill. A noted character named Billy O'Rourke (dubbed the Prince of Brefney) was foreman. This was in 1887 and 1888. I also single-jacked in many places through Queensland and N. S. W. before going to W. A.

While I am not in a position to know whether the Cornishman first introduced single-hand methods into mining or not, one thing I do know and that is that the Cornishman knew what a single-jack was long before the time of Mr. Hoover's first arrival in Western Australia.

MICHAEL MERRICK.

Wickenburg, Arizona, December 20, 1920.

The Greenawalt Sintering Process

By William E. Greenawalt

INTRODUCTION. The Greenawalt sintering process, the invention of John E. Greenawalt, is an intermittent operation. The basic idea of the apparatus and process is briefly and best described in the words of the original patents, as follows: "In a furnace for treating ore or other material, the combination of a porous bed or hearth, and means for passing air or gas downwardly through material and the hearth upon which it rests." And for the process: "The process of treating ores or other material upon a porous bed, subjecting the material to heat, and passing air or other gases down through the layer and the porous bed."*

The Greenawalt process, as practically developed, is intermittent in operation. A charge of the material to be sintered is placed in a pan-shaped furnace and subjected to a down-draft blast of air; the upper surface of the charge is ignited and the sintering action proceeds through the charge from the top downward. After sintering, the charge is dumped from the pan and the operation repeated.

The apparatus for carrying out this simple operation has been developed to a high state of efficiency. It is simple in operation and rugged in construction. The capacity in present operating plants ranges from 20 to 1000 tons of sinter per day. Fig. 2 shows the general arrangement of a Greenawalt sintering plant of medium size.

A complete Greenawalt sintering installation consists essentially of the furnace in which the charge is sintered; an exhaustor which creates a blast of air downward through the charge; a mixer; a charge-car; and an igniter. The mixer, the charge-car, and the igniter, may serve from one to ten or more sintering-pans.

MIXING THE CHARGE. This is an important preliminary step to sintering. A properly mixed and proportioned charge sinters readily and the resulting sinter is usually in large chunks. A poorly mixed, or poorly proportioned, charge is likely to give inferior results, in which a considerable portion of the charge has to be returned for re-sintering, whereas, in a properly mixed charge the entire mass may frequently be sintered into one large cake. The charge to be sintered should have about 10% moisture. The mixing may be done in a rotary drum like a concrete-mixer, in a rotary cylinder, or in a pug-mill. With thorough mixing, the charge becomes uniform in moisture and the combustible content is evenly distributed through the charge.

The combustible content of the charge is important. It is practically impossible to get a good sinter from a concentrated sulphide material, or from iron-ore fine,

containing an excessive amount of coke. The sulphur content in sintering lead or copper ores may vary from 5% to 15% sulphur. In sintering iron-ore flue-dust or magnetic concentrate the coke content may vary from 3% to 10% carbon. A good sinter may be made on some charges with as little as 2% carbon. Ordinarily, from 4% to 6% carbon, in the sintering of iron-ore flue-dust, will give the best results. In the sintering of copper-ore fine or flue-dust, from 5% to 10% sulphur will give uniformly good results. In sintering iron-ore fine, low in sulphur, the sulphur can be removed almost entirely. On the other hand, when it is desired to retain a high percentage of sulphur in the sinter, as in sintering copper-ore fine for the blast-furnace, this may be done by stopping the operation after the material has been sintered and before the sulphur is all removed. In cases where the material to be sintered contains too much combustible, such as coke or sulphur, the best method to adjust it is to dilute it with other fine material desired in the blast-furnace charge, such as any fine having a low combustible content. In sintering copper-sulphide concentrate the sulphur content can usually be adjusted to the desired amount by mixing flue-dust or fine crude ore with the sinter charge. In cases where such mixtures cannot well be made, as in galena concentrate, the material may be pre-roasted to bring the sulphur down to about 12% or 15%. Pre-roasted material sinters readily. The moisture in the charge, to get the best results, may vary somewhat with different material, but 10% moisture will be found a fair average. The best amount of moisture for any particular material is best determined by experiment. Usually the moisture content should be such that when a handful of the mixed material is compressed, it will retain its shape without being soggy.

In small installations, a small concrete-mixer or a small pug-mill will ordinarily be used. Hand-mixing may be done, but this is not recommended, even in the smallest plants, except for experimental purposes or as a temporary expedient.

THE SINTERING-PAN. Fig. 2 shows a typical medium-sized Greenawalt sintering-pan. It consists, essentially, of a pan-shaped sintering-furnace, mounted on hollow trunnions, and divided into an upper and a lower portion by the grates. The upper portion receives the charge for sintering, and the lower portion communicates, through the hollow trunnions, with the exhaustor, which creates a suction in the lower portion, or chamber, and causes a flow of air downward through the charge and through the hollow trunnions and exhaustor into the stack. The grates are secured to the pan and interlocked. They are easily inserted and easily removed.

*U. S. patents, No. 839,064 and 839,065, December 18, 1906.

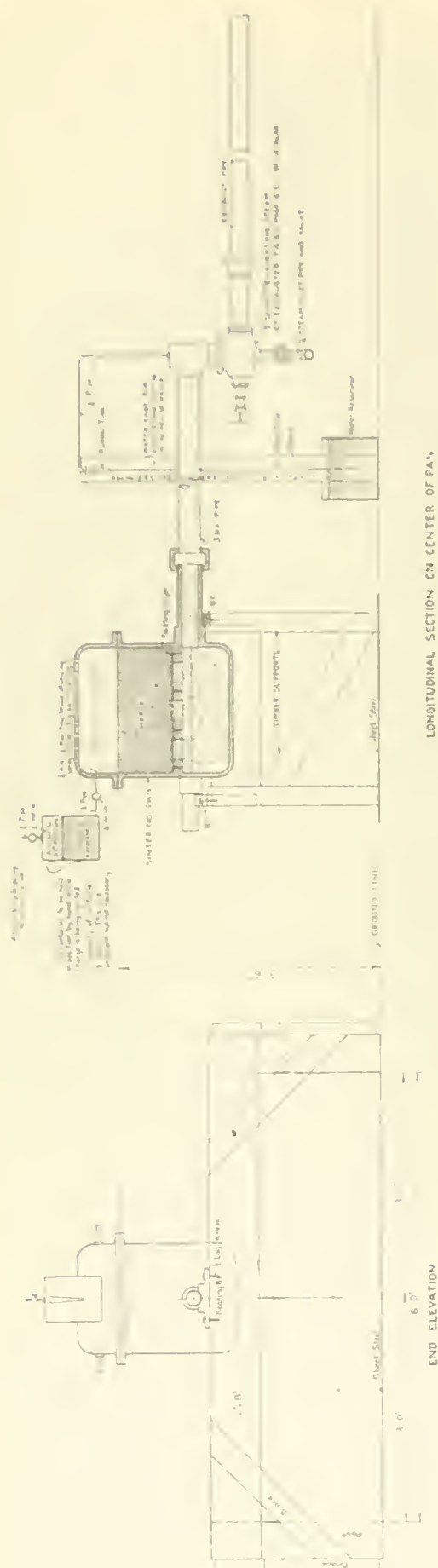


FIG. 1. SMALL UNIT FOR SINTERING TESTS

The sintering pans are made in sizes to correspond with the ultimate capacity of the plant. The usual sizes are, 6 by 8 ft., 8 by 12 ft., 9 by 16 ft., and 10 by 24 ft. The depth of the charge is the same for all the pans and varies from 8 to 10 or more inches, depending on the material to be sintered. The 6 by 8 ft. pan represents the smallest commercial unit and has a capacity, under ordinary conditions, of about one ton of sinter per charge. The 10 by 24-ft. pan is the unit for the larger installations, and has a capacity of from 150 to 250 tons per day of 24 hours. These larger pans are arranged to dump directly into standard railroad cars. A sintering plant usually contains from one to ten or more pans.

The pans are made of cast-steel and are practically indestructible. They are rotated on hollow trunnions by means of a special mechanism. When the sintering is completed the pans are rotated to dump the sinter and rotated back into position for a new charge. The small pans may be dumped without any special rotating mechanism. Connection is made with the exhauster by means of a stuffing-box at the ends of the hollow trunnions.

EXHAUSTER. The exhauster is usually of the regular fan type. It is rotated at a high speed and has to be well made and the exhaust-wheel well balanced. A suction of from 30 to 35 in. of water is easily obtainable in the sintering-pans by this means. This is due largely to the fact that in the stationary charge there is no leakage and all the air and gases have to pass through the charge to get at the chamber below and through the hollow trunnions to the exhauster. There is an advantage in using a high suction. The sintering is more uniform, there is less unsintered fine, and the sinter is firmer and in larger chunks. In sintering iron-ore flue-dust, if the coke content is a little high, water is sometimes showered on the charge to cool it during the sintering. The temperature on such occasions may rise so high as to liquefy portions of the charge. The best way, however, to avoid this condition, is to work with a lower combustible content. It is, of course, desirable to sinter a charge at as high a temperature as practicable to get a firm sinter and as large chunks as possible, for the reason that the firm hard chunks add considerable to the desirability of the sinter in the operation of the blast-furnace.

THE CHARGE-CAR. The charge-car receives the mixed material and delivers it to the pan. In charging the pan, the car spreads a porous bed, or layer, of non-sinterable material over the grates, delivers the charge on top of the permeable layer, and levels the charge even with the top rim of the pan. This is all done in a few seconds—while the car travels with moderate speed over the pan. The charge-car is usually motor-driven, but may be moved in any other convenient way. In small units the pans may be charged with hand-labor by simply spreading a permeable layer over the grates and shoveling in the charge and leveling it. This adds somewhat to the cost of sintering, but saves a little in the cost of installation. It may also do as a temporary expedient. The porous bed, or permeable layer of non-sinterable material, which usually varies from $\frac{1}{4}$ to $\frac{3}{4}$ in. thick, serves several impor-

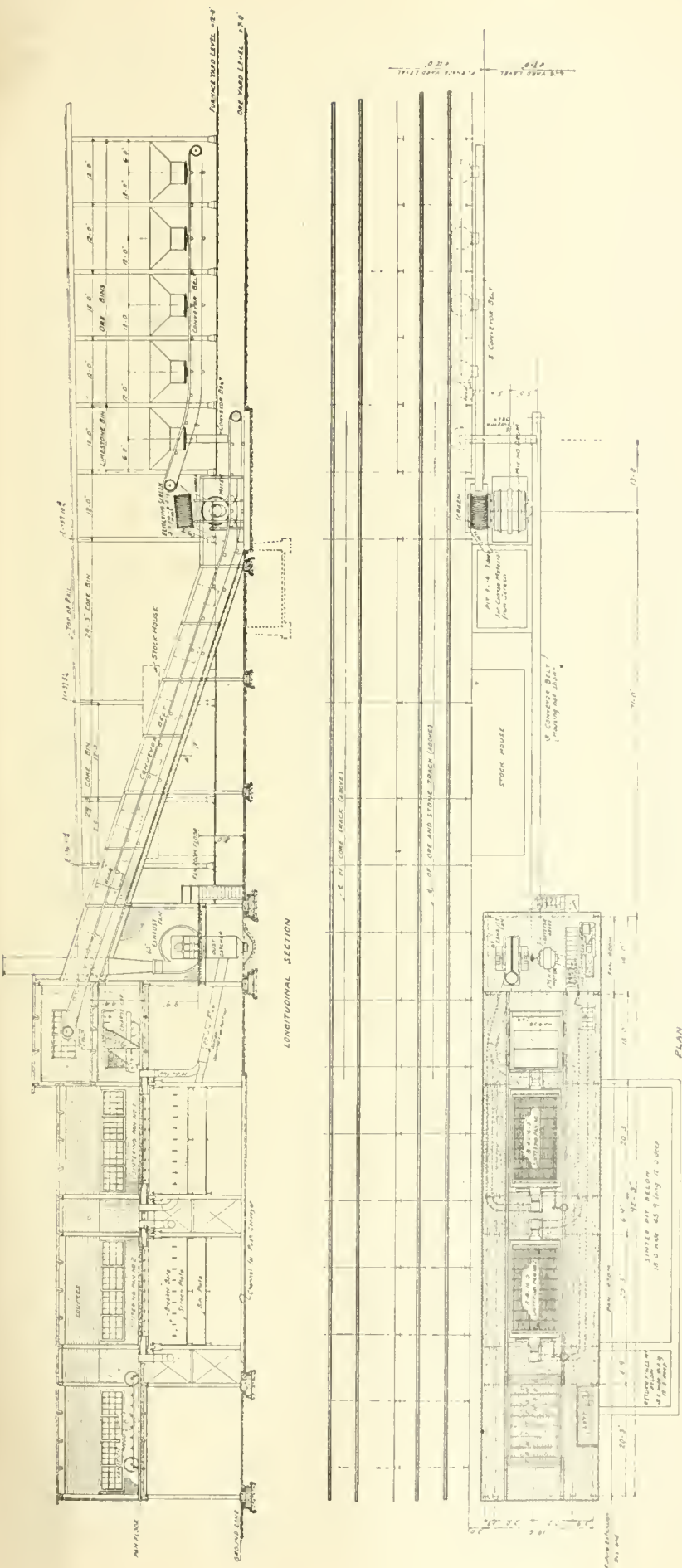


FIG. 2. GENERAL ARRANGEMENT OF SINTERING-PLANT

tant purposes: it prevents the fine material of the charge from passing through the grate; it serves to distribute uniformly the air passing through the charge; and it prevents the charge from being sintered to the grates. If the charge were placed directly on the grates and the sintering completed, the charge would be sintered to the grates and the removal of the sinter would be difficult and expensive; besides the grates would be quickly destroyed. This porous bed acts as a buffer between the grates and the charge, so that when the pans are inverted the entire charge drops out and leaves the grate clean. The porous bed may be any comparatively non-sinterable material, such as fine sinter, crushed limestone, or crushed silicious or oxidized ore.

THE IGNITER. The ignition is one of the most important steps in sintering. Unless the ignition is uniform, the sintering will be uneven and some of the charge will remain unsintered. If the ignition is uniform the sinter will always be good on a suitable charge, and little fine will have to be returned. Manifestly, the quick and uniform ignition of the entire surface of the charge presented something of a problem, especially in connection with the 10 by 24-ft. pans. This problem was thoroughly solved by the ignition-hood, or igniter, which temporarily covers the charge while the ignition-fuel is projected over the entire surface of the charge. The air for the combustion is sucked through the numerous perforations in the hood.

The ignition-fuel may be oil or gas. Both are being used successfully. Crude oil is satisfactory. Distillate, or kerosene, is a good ignition-fuel if cheaply obtainable. Gas is usually cheaper than oil. Either natural gas, blast-furnace gas, or producer-gas may be used and are giving excellent results. The combustion should be complete. A sooty flame is not as good as a flame which does not show any unconsumed carbon. The oil or gas is so finely atomized and so intimately mixed with the inrushing air through the perforations in the hood that there is little or no difficulty in getting a clear flame. When the combustion is complete the temperature in the igniter is intense. The ignition can usually be made in a minute. The

igniter itself does not become very hot; this is due to the cool rushing air and to the momentary time required for ignition.

In the operation of a commercial plant the igniter is mounted on wheels and runs on the same tracks as the charge car. The hood, or igniter, is normally about half an inch above the upper rim of the pan, so that it can be freely moved over all the pans. When ignition is to be made the hood is temporarily lowered, and makes a close connection with the pan, so as to give a uniform ignition over the entire surface of the charge, and especially around the edges. If it were not for this, the rushing air around the perimeter of the pan would divert the flame, and result in incomplete ignition. When the ignition is made, the hood is raised, and the igniter is ready for another pan.

After the ignition has been made the sintering of the charge proceeds without the igniter. The igniter is usually motor-driven, the same as the charge-car. For the smaller pans the igniter may simply be pushed from one pan to the other. If oil is used for ignition, it will usually take from 0.75 to 1.0 gallon per ton of sinter. In a small plant, in Mexico, sintering copper concentrate and flue-dust, the oil consumption was materially reduced by sprinkling a little waste coke or charcoal dust over the top of the charge. It was found, in this connection, that if fine coke or charcoal were mixed with the sinter charge of copper concentrate and flue-dust, that much of the carbon would remain unconsumed and fixed in the sinter so as to make it available in the blast-furnace.

SINTERING THE CHARGE. The sintering of a charge may be briefly described as follows: The mixed material, as also the porous bed, is delivered to the charge-car; the car is then run over the pan, and in passing over it, the porous bedding is uniformly spread over the grates by the distributor at the front of the car, and the charge immediately placed upon the bedding and levelled off with the top rim of the pan. This usually takes less than a minute, even for the 10 by 24-ft. pans. The exhauster is then started, or switched on to the pan. This creates a strong downward draft of air through the charge. The igniter is then run over the pan and the ignition-fuel, under a high pressure, is atomized over the charge and ignited. The flame and hot products of combustion are sucked down through the charge and completely ignite the surface, usually in less than a minute. The igniter may then be removed and used for another charge. The sintering proceeds until the entire charge is sintered. The time of sintering may vary from 15 to 60 minutes, depending on the nature of the material and the results desired. The suction may vary from 10 to 35 in. of water. It is usually more at the beginning than at the end of the operation, for the reason that at the beginning the mass is not as permeable. With a high suction, there is not so much danger of short circuits of the air through the charge; when a short circuit occurs, the temperature at that point becomes so intense as to cause fusion, which automatically has a tendency to close the larger air-passages through the partly sintered charge, and make

the sintering more intense at other portions. When the sintering is complete, the exhaust is shut off, the pan mechanically rotated, and the sinter dumped. The pan is then rotated back to its normal position, and the cycle repeated. In some of the large plants the cycle is completed in about 20 minutes.

The power required for sintering depends somewhat on the nature of the material to be sintered. Ordinarily it will be from 5 to 6.5 kw-hr. per ton of sinter. The repairs are small and consist principally of the replacement of grates.

FLEXIBILITY OF THE PLANTS. The plants are exceedingly flexible, both in installation and operation. It will be noted that the charge-car and the igniter are used only a few minutes for each charge. Similarly, in the first unit, the mixing, conveying, and elevating machinery, will usually be far in excess of the requirements, or can be cheaply made so. The capacity of a one-pan plant can therefore be doubled at any time and at small expense, by simply adding another pan. It may be trebled by adding two pans, etc.

The plants may be operated as desired; each pan may be operated independently of the others, and one, or all, of the pans may be operated for one or three shifts, since each cycle of sintering in each pan is complete in itself. This makes it possible to start with a small installation, and later, if desired, the capacity can be increased as needed. Or, in a plant normally operating a number of pans for 24 hours, any of the pans can be cut out at any time and the working force reduced to one shift without materially affecting the operation, so far as the apparatus is concerned.

PRELIMINARY SINTERING-TESTS AND APPARATUS. The sintering results on any material can readily be determined by the Greenawalt process with a small laboratory equipment, as shown in Fig. 1, made by the Colorado Iron Works Co. of Denver. Any good mechanic can set it up at the works ready to operate, in a few hours. This equipment represents a unit of all the working pans. The suction is obtained by connecting the Schutte-Koertling ejector to a steam-boiler. It has been found by years of experimentation and testing with such an equipment as this, that the results obtained in this small pan are absolutely reliable, and can be duplicated in the commercial installations. There never has been a single disappointment when commercial plants were installed on the basis of the results obtained with this miniature Greenawalt sintering plant, which, it must be remembered, represents a full-sized section of all the pans. A water-gauge records the suction, and the suction may be varied as desired for different charges. This small pan holds about one cubic foot of the material to be sintered. It offers a cheap and convenient apparatus for trying out the sintering qualities of different mixtures and with various suctions.

OPERATING GREENAWALT PLANTS. There are a large number of Greenawalt plants in operation in different parts of the world, sintering various materials, and varying in capacity from 20 tons to 1000 tons per day. There

have been two 1000-ton plants in operation for some time; one sintering magnetic concentrate, and the other sintering iron-ore flue-dust. Both are now being enlarged to a capacity of 2000 tons per day. The 10 by 24-ft. pans are used in these plants. The sinter is dumped directly into a train of railroad cars and shifted to the blast-furnaces. Smaller plants are in operation sintering lead ore, copper concentrate, iron ore, and copper fine and flue-dust.

SINTERING V. DRYING OF TABLE AND FLOTATION CONCENTRATE. Several interesting problems arise in reference to sintering by the present method. One is the possibility of sintering concentrate for shipping instead of drying. Sintering requires about 10% moisture. Drying of the concentrate, if sintering is contemplated, would therefore be unnecessary and could be eliminated. Concentrates contain their own fuel for sintering, as opposed to extraneous fuel which has to be purchased for drying. The sinter would be ready for smelting, and the shipping weight would be reduced to from 15% to 20% from the ordinary dry-shipping weight. This reduction in weight is due to the replacement of the sulphur with the lighter oxygen, to the elimination of the water of hydration, to the elimination of other volatile elements, and to the evaporation of the uncombined moisture, which in ordinary drying is never complete. A reduction of from 15% to 20% in the shipping and smelting weight will ordinarily much more than pay for the sintering. If the sulphur content in the concentrate is too high for sintering, the charge can almost always be diluted with fine shipping ore low in sulphur, and this would tend to give a greater porosity to the sinter charge, especially in the sintering of flotation concentrate. The following advantages would, therefore, be gained by sintering instead of drying: First, drying would be entirely avoided, since the moisture is necessary in the mixed sinter-charge. Second, the concentrates furnish their own fuel for sintering (except the ignition-fuel) as opposed to the fuel which has to be purchased for drying. Third, reduction in weight both for shipping and smelting of from 15% to 20%. Fourth, the saving in sacking, where the fine concentrates are sacked to prevent excessive loss. A sinter-pan for this work could be cheaply installed. The sinter would, of course, be more desirable for the smelter than the raw concentrate, but while this might be of interest to the smelter, it would be of no interest to the shipper, unless some small allowance should be made for the better character of the material.

SINTERING AND BLAST-FURNACE SMELTING V. ROASTING AND REVERBERATORY SMELTING. The sintering of fine ore and concentrate brings up the very interesting problem, in copper smelting, as to the relative merits of blast and reverberatory smelting. The pendulum, which swung from the blast-furnace to the reverberatory, may swing back again. The roasting of sulphides preparatory to smelting, may be somewhat cheaper than sintering, but the difference is not serious. The dust, in roasting of fine sulphide, is considerably more of a problem than in sintering the same material, for sintering produces only a small amount of dust as compared with ordinary roast-

ing. The sintering of sulphide, such as flotation concentrate, presents a difficult but not insurmountable problem. It also presents a problem in ordinary roasting. In reduction-works, smelting both mine ore and concentrate, the conditions are different. The elimination of the fine material from the blast-furnace greatly increases its capacity, and the sintering can usually be made a method of satisfactory fluxing. In one installation, under the writer's general direction, the capacity of the blast-furnace was increased from 85 tons per day to 250 tons per day on a test-run of the Greenawalt equipment. This increased capacity was primarily due: First, to the sintering of sulphide concentrate, high in iron as well as in gold and copper; the product was used as a flux, which was lacking in previous operations. Second, to the elimination of a large portion of the fine material from the blast-furnace charge by mixing with the concentrate to form the sinter. Third, to some changes in the design of the furnace. In the previous operations 25% limestone was added as a flux; this was in whole or in part replaced by the high-iron sinter in the test-runs. A higher-grade matte was also obtained. It was highly profitable to replace the barren limestone flux, with a high-iron sinter, having from \$20 to \$25 in gold and copper per ton. The concentrate was from mine-ore too low in grade to smelt direct. The dilution of, say, a \$10 smelting ore, with 25% barren limestone as a flux, would make a furnace-charge worth about \$7.50 per ton; the enriching of the \$10 ore, by fluxing with a high-iron sinter having, say, \$20 in gold and copper, would give a furnace-charge worth \$15 per ton, as compared with \$7.50. The cost of smelting a ton of \$15 mixed charge would not be any more than for smelting a ton of the \$7.50 mixture, either for fuel or labor. It would probably be less. In the particular instance cited, it was considerably less.

There are many conditions, however, to be considered in blast and reverberatory smelting. The fuel available will probably be the determining factor in most cases where both methods are applicable.

A RECENT ISSUE of the 'Journal du Four Electrique' contains a description of the process introduced by Gustav Laval and worked by the Norsk Elektrisk Metal Industri, at Sandlokken, Norway, for the electro-thermic distillation of zinc by direct treatment of the ore. The plant comprises a series of electric furnaces having a daily capacity of from 3 to 5 tons of zinc each. This method is said to result in a considerable saving of labor and fuel. At present 15,000 tons of ore per annum is treated at the works, and the company is completing a new hydro-electric plant on the west coast of Norway, with a capacity of 30,000 hp., for applying the Laval process on a larger scale.

FROM July 1 to September 30, 1920, inclusive, 2045 flasks of quicksilver, of 75 lb. net, was produced in the United States. If the present rapid decline continues, as now appears probable, the total for the year will be less than 12,000 flasks, 9000 flasks less than for 1919.

Engineering Foundation: Its Work and Needs

By ALFRED D. FLINN, Secretary

Engineers and scientists have created modern civilization. They have founded it upon facts, won by research from the inexhaustible storehouse of Truth. Simultaneously they have put into the hands of the enemies of civilization the weapons of destruction. That American engineers in many ways aided in averting the recently threatened catastrophe, is generally acknowledged; but one of their instrumentalities is known to few even among engineers. To this instrumentality the world war was no more than a great event in its childhood; it looks forward to unmeasured years of service in peace and progress. If, however, war should again become inevitable, again will this instrumentality be one of the readiest factors in preparedness.

In 1914, Ambrose Swasey, of Cleveland, Ohio, a past-president of the American Society of Mechanical Engineers, gave to the United Engineering Society the sum of \$200,000 as the nucleus of a trust fund, the income from which should be used "for the furtherance of research in science and engineering, or for the advancement in any other manner of the profession of engineering and the good of mankind". The United Engineering Society, as the incorporated board of trustees holding joint properties for the American societies of civil, mining, mechanical, and electrical engineers, organized the Engineering Foundation Board to administer the income from the trust-fund. The Foundation was allotted offices in the Engineering Societies building, New York. In September 1918, Mr. Swasey gave an additional \$100,000.

In April 1916, the National Academy of Sciences offered to President Wilson its services in organizing the scientific resources of the country in preparation for the evidently unavoidable participation in war. In response to a request from the President, the Academy, with the co-operation of the national scientific and engineering societies, organized the National Research Council. No fund and no home having been provided, Engineering Foundation offered its offices, its financial resources, and the service of its secretary for one year from September 1916. Thus, as its first work, the Foundation succeeded the Research Council until greater provision from private and governmental sources could be made. Through the Foundation and the national societies the engineers co-operated with the Council during the War and in the period of reconstruction; they have a permanent place in its peace organization and projects. National Research Council now has an endowment of a few millions and a fund for the erection of a suitable building at Washington.

The Engineering Foundation is a response to the need for research, other than that of the Government and of large corporations, beyond the means of individual engi-

neers, small companies, and separate societies. The Foundation has an endowment of \$300,000, an organization based on the national engineering societies, and means for publicity. It can receive and administer funds; support researches by individuals or organizations; establish and operate laboratories; aid in applying the results of research; stimulate interest among engineers, and enlist support for these purposes.

For the engineering societies, Engineering Foundation is their joint agency for research, and a liaison with scientists through the National Research Council. With National Research Council, the Foundation co-operates in stimulating and co-ordinating research by governmental, educational, industrial, and private agencies.

The Council has a Division of Engineering, the purpose of which is: "To promote research and the application of the sciences to engineering." Engineering Foundation may use its funds "in any manner, for the furtherance of research in science and engineering". Therefore, Engineering Foundation may undertake any kind of work that the Division may undertake, and others besides. Confusion is avoided through the intimate relation between the Foundation and the Council and frequent communication between the offices of the Foundation and the Division. Even in their common field there is work enough for both; and by agreement upon program from time to time, interferences will be escaped. The peculiar value of the Division arises from its being an integral part of the National Research Council, the national federation of scientists and engineers for promotion of research, and therefore being in a position to place before scientists the engineering problems that require scientific research, and to inform engineers of the activities of scientists that may affect engineering. Engineering Foundation can contribute to the support of the Division, can share in its deliberations through interlocking membership, can benefit from its work, and can have its advice as to researches that may profitably be supported by the Foundation. Independently, the Foundation may establish and maintain laboratories, support or conduct researches, and contribute results to the engineering societies. The Foundation and the Division each is essential to the engineering profession for purposes of research, but the activities of the two must always harmonize.

With the scientific bureaus of the Government, the Foundation can exchange information; make more available to engineers results of researches by the bureaus; suggest to the bureaus how to make their researches more helpful. To the Engineering Societies Library, the Foundation can extend aid in making this library the repository of all information about research relative to engineering.

What needs can the Engineering Foundation supply better than any other organization? Direction and support of research relative to engineering, of such nature as not to be undertaken by an industrial corporation, the Government, or a university; collection and publication of information about research of particular interest to engineers, utilizing engineering journals.

Should Engineering Foundation establish an Engineering Research Institute and Laboratory? Some thoughtful men believe that it should, to supplement the university training of promising researchers; to provide place and means for research by engineers and inventors, and for limited co-operative research for industries. The laboratory might be made partly self-sustaining. For some kinds of work or training, charges might be made, particularly for those not of general interest, and for those from which a profit will be realized. An establishment under Engineering Foundation would have an independence and celerity of action not feasible in a governmental laboratory and would be able to conduct researches on a scale and in an atmosphere of practical requirements not possible in a university. In the course of years, there might be more than one laboratory, each situated where it would have the best conditions and be most useful.

By conserving for a few years a large part of its meagre income Engineering Foundation was able, in May 1919, to appropriate \$30,000 for the support of an extensive research in the fatigue phenomena of metals. This expenditure will be spread through two years. The tests are being made at the Engineering Experiment Station of the University of Illinois under the general auspices of National Research Council. The University contributes certain services, equipment, and facilities, and provides the working-space, estimated as equivalent to \$12,000. Some manufacturers are furnishing specimens. Recently the General Electric Company, one of the largest industrial corporations in our country, asked to have the program of tests broadened, at its expense, to an amount equal to that provided by the Foundation. The purpose of all these investigations is to obtain further knowledge about the behavior of parts of machines and structures subjected to many repetitions and variations of stress. These tests are in active progress under the direction of H. F. Moore, assisted by J. B. Kommers, of the University of Wisconsin. The expenditure will probably total \$75,000.

From fifty or more suggestions received from many sources, the Foundation Board selected from time to time for investigation a few that demanded only small expenditures. A study of the wear of gears begun in 1916 was interrupted by the War, but was resumed in the summer of 1920. It is being conducted at Stanford University, by Guido H. Marx and Lawrence E. Cutter. To aid in solving the problem of protecting ships from attacks by submarines, Engineering Foundation, in November 1917, joined with the New York committee on submarine defence in making, under the direction of H. P. Quick, experiments on concealment by means of spray from special nozzles disposed at suitable points on the

ship. The U. S. Navy lent a barge and other equipment. A number of tests made in New York harbor led to the conclusion that the method was not practicable. Foundation made a small appropriation for a special study, at Columbia University, of some features of the secret directive control of wireless communication.

Many experiments have been made upon weirs as a means for measuring flowing water and other liquids. Several elements of the problem remain unsolved, and others have not been satisfactorily solved. In December 1918, an appropriation not to exceed \$2500 was made for an investigation to be conducted under the direction of Clemens Herschel, hydraulic engineer, in collaboration with the hydraulic laboratory of the Massachusetts Institute of Technology. This investigation resulted in an improved form of weir for gaging the flow of liquids in open channels. Mr. Herschel presented his report in the form of a paper at the spring meeting of the American Society of Mechanical Engineers, at St. Louis, in May 1920.

In December 1918, Julius Alsberg, consulting hydraulic engineer, suggested the establishment of a testing-station for large water-wheels and other hydraulic equipment. Silas H. Woodard, H. Hobart Porter, and Calvert Townley were appointed a committee to inquire into this subject. This committee reported in May 1919, that such a testing-station was not practicable, that it is not advisable to establish a testing-flume for small models because existing flumes meet all requirements, but that testing of water-wheels now in place would be useful and practicable.

In February 1919, the Foundation authorized E. E. Southard, director of the Massachusetts State Psychiatric Institute, to make a preliminary investigation as to the part played by mental abnormalities in industry. Upon the presentation of a report in May, showing satisfactory preliminary results, for which an expenditure of \$300 had been made, \$2500 was appropriated for a research in mental hygiene of industry to be made under Dr. Southard's direction during the year beginning June 1, 1919. W. F. M. Goss, J. Parke Channing, E. W. Rice, Jr., and Thomas T. Read were appointed an advisory committee. The objects of this research are to develop or discover methods for adapting psychopathic individuals to usefulness in industry and to prevent them from becoming sources of disturbance, in so far as these ends may prove attainable. Dr. Southard died suddenly on February 8, 1920, leaving much of his work unfinished.

The Foundation Board realized, however, that the research in mental hygiene of industry dealt with only one of many elements of the industrial personnel problem. Therefore, in June 1919, the Board addressed to the National Research Council a letter proposing a co-ordinated broad research in problems of industrial personnel. In response, the Council appointed a committee consisting of representatives of its divisions of Anthropology and Psychology, Educational Relations, Engineering, Research Extension, and Medicinal Sciences, the secretary of Engineering Foundation, and the chairman of the National Research Council, to consider means of furthering the study of the problems of industrial employment.

Storage-Bin With Louvred Hoppers

By NEWTON L. HALL.

Difficulty is frequently experienced in preventing 'hang-ups' in storage bins. Delays are caused which are expensive not only because of the additional work required to get the material again into motion, but because of the time lost in subsequent operations due to the interruption of service.

Most bins have closed or continuous sides and this rule generally applies to the gates, the feeders, and the hoppers. A tight bin is sometimes necessary, but not often. Barring tightly packed material with a long rod from above the bin is a tiresome and expensive operation. Hammering the sides of the hoppers with heavy sledges is inadvisable, and yet it is a common practice when bins for custom ore must be thoroughly cleaned before the next charge is received.

The discharge opening of a bin can be made to retain the material, no matter how finely it is ground, by placing openings or 'louvres' over the gate-opening, that is, 'dash-boards' placed at an angle but in vertical line with space between them. The spacing of the boards is arranged according to the angle of repose of the particular material. This idea can be applied to the sides and hoppers of storage-bins, which, for the want of a more appropriate name, can be termed a louvred bin.

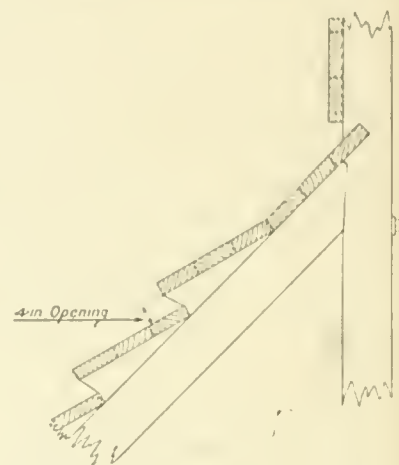
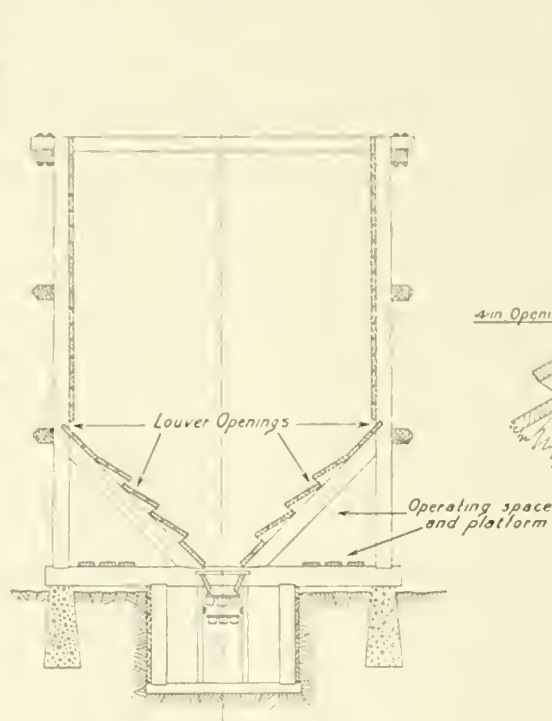
In its design, a louvred bin of wooden construction is framed in much the same manner as a plain bin. In the accompanying sketch the wooden bin has a double sloping bottom with central-discharge openings. The first two boards over the diagonal beams of the framework are laid as they would be in a plain bin. Above this first course and on the diagonal beams of the frame, wedge-shaped cleats of the width of the beams are laid with their points upward, and over these cleats the next course of two boards is placed so that there is a vertical opening between the top of the first and the bottom of the second course. Succeeding courses above are placed in the same manner with a louvre-opening between. These courses should be 24 or 30 in. wide with a 4-in. louvre between each course.

At the corners of the bin, where the sloping bottom meets the vertical sides, another louvre-opening should be provided by extending the bottom out and beyond the vertical siding so as to leave a 4-in. vertical opening at the junction of the two sides.

The load within a plain bin tends to pack as it descends toward the discharge-gate opening. Usually no means are provided to relieve this tendency to pack. The sides

of the bin are so formed that the weight and convergence of the load accumulates its pressures to an extent that causes that part of the load next to the bin sides to stick, and if the ore is not dry, the centre of the load moves and causes a 'piping' of the outer part.

In a louvred bin the load descends as in a plain bin, but at each louvre opening the friction against the side is decreased and the accumulation of pressure relieved. When the load does stick it can be prodded through the louvre-opening from the outside. The louvred bin serves two distinct purposes: it can be designed to maintain the mobility of any granular load, and it exposes the load



SECTION AND DETAIL OF LOUVRED BIN

so that it can be barred or prodded from the outside at the most advantageous point.

The principle of the louvre-opening can also be utilized at the gate-opening. Bins are frequently constructed with the discharge-gates in the side of the bin as if the first object of the gate was to close the opening perfectly tight, and yet a louvred gate would give better service. Placing the gate a short distance away from the bin and leaving a space between the gate and the bin open at the top not only removes the gate from much of the direct pressure of the load, but allows the load to assume an angle of repose before reaching the gate.

Milling plants throughout the country too frequently have bins that are of needlessly tight construction; their loads are inaccessible, whereas an open construction would give better service. Bin-gates are made of complex design when all that is required is a simple gate proportioned to the size of the material. Designs incorporating the louvre are not new and their practicability has long been demonstrated. A liberated load brought to its natural repose ceases its movement and localizes its zone of action. The application of this principle is illustrated in the design described in this article.

A Defence of Minerals Separation

By Alfred A. Cook

*I wish that I could have had the opportunity of familiarizing myself with the papers read by Mr. Nye and Mr. Montague before they were read. I might then have had the privilege of presenting to you in written form such views as I thought might be germane to the discussion and helpful. I say "helpful", because I think that anything which affects the mining industry, should prompt anyone interested in any of its component parts, to do his share in the work of usefulness and co-operation. I could then have eliminated all things which were not controversial, and could have reduced a discussion of differences to fundamentals and the facts.

What did the American Mining Congress do? Instead of coming to us or even writing to us through its secretary, it filed allegations and charges, and impressed the Federal Trade Commission with the fact that the Minerals Separation Companies are German-owned and German-controlled. A year ago at St. Louis, an address was read by Mr. Nye, page after page of which charged Minerals Separation with functioning in this country as a German-owned and German-controlled concern. Now, to my mind unless the facts substantiate a charge of that kind, that is going not only far afield but is hitting, if I may say it, below the belt.

In this article the assertion was made that two gentlemen residing in England were in effect secret German agents and through their ownership or control of a majority of the shares, arrangements were made so that Minerals Separation could function in this country as a German-owned and German-controlled company. Who were these two? If any of you have some of these reprints I refer to, you can see mention of the names of Kindersley and Pusch. Who were they? Kindersley is Sir Robert Kindersley, a director of the Bank of England, Governor of the Hudson Bay Co., and throughout the war the head of the War Savings and Victory Loan movement of England, recently knighted and given by his King the honors that fall to honest and deserving patriots. And who was Pusch? A Russian who came to England years ago, a naturalized Englishman who lost two of his sons, officers in the English cavalry in the war, and when England sent a commission to Russia during the war he was either one of the members or the head of that commission.

Now, of course I know the force and effect of propaganda. I know that a rumor here and a rumor there grows and grows and forces itself throughout any industry, throughout any community, and even gets to the ears of the Government, and so, practically at the instigation of the American Mining Congress, we had visited upon us for weeks and months the Alien Property Custodian,

who goes through our affairs from beginning to end to determine whether this charge of German ownership and German control is correct. And the Bureau of Mines comes, and the Federal Trade Commission comes, and every conceivable Government agency. You heard this morning the reading of the articles from the Canadian press. Away back in 1917 the Canadian government examined us. You heard the charge made, that if in Canada royalties are unreasonable, the patent is forfeited; and yet after all that investigation by the Canadian government, Minerals Separation cleared itself completely. Now, there must be some reason and some element of justice in the decision. Of course, you may very properly say: "Well, this charge of being German-owned and controlled is an old thing," and so forth and so on. I am speaking of it to you, because I never believe in fighting a fight through newspapers, or periodicals, or other journals, when there are properly constituted tribunals before which to wage the fight. So far as the two gentlemen whose names were mentioned are concerned, I did call the attention of the Mining Congress to the great injustice that it had done them, and to its credit be it said that an apology was forthcoming.

Let me take up another matter. Recently there appeared in the 'Engineering and Mining Journal' an article headed: 'Western Hearings of Minerals Separation Companies by Federal Trade Commission', and there were quotations in that article, or attempted quotations, as there were quotations this morning. I have not had the opportunity to read the quotations in the article read this morning, so I do not know whether everything was there or whether the cross-examination affecting the various matters was there, or whether there were eliminations and the usual stars to denote eliminations. Just let me however call your attention to this particular quotation appearing in the article just mentioned. This statement is made: "One licensee who testified that his relations with Minerals Separation had been pleasant said: The royalty is too high * * * We regard it as entirely too high * * * It becomes a very burdensome charge." Now, those words were used, but they were used in connection with other words, and my only thought on the subject, as long as we are going to have a fight, if it must be and I hope it need not be, let us be fair with each other and play the game. This is what was testified to by the witness: "I do not say I regard it as too high under those conditions. I say, under present conditions we regard it as entirely too high. When I am not making any money at all, it becomes a very burdensome charge." Whether that is helpful to the Mining Congress or not, we were entitled at any rate to have quoted what was said.

You heard this morning in, I think, Mr. Nye's address,

*Extracts (by the Editor) from a speech delivered before the American Mining Congress on November 17, 1920.

something about Mr. Nutter using the language "sinning against some one" or other, and yet, Mr. Nutter was not responsible for that. Mr. Nye might have told you that Mr. Hawkins, representing the Federal Trade Commission, when he put the question said: "What were Mr. H's sins, what was his infringement, how was he sinning?" And that Mr. Nutter then answered as quoted. Now, in the article that I refer to, in order no doubt to impress the representatives of the American Mining Congress that Mr. Nutter did not know what the infringements were, and that he simply charge infringement without any knowledge of the facts and that adjustments and settlements were made by reason of power or coercion, or call it whatever you please, Mr. Nutter was quoted as saying "I don't know". This however is what is omitted: "He admitted that he was infringing, so I did not go back of his statement to me." Now, take another instance referred to, that about the Evergreen Mining Co., where, Mr. Hollister, I believe, was asked: "If you do not fear the litigation by the Minerals Separation Company, with the price of copper as it is now, would you reopen your mill or not?" and he answered "Very probably we would." If however you examine the testimony of Mr. Hollister, you will find that he said that they had troubles at the mill with their machinery and it was on that account that it was closed. It is very short so I will read the testimony.

"Q. Did you sell your concentrates prior to 1917?

A. Yes sir.

Q. What do you mean by operating on a commercial basis? Operating on a profit?

A. No, we were in such bad shape up there that our mill was closed down most of the time, and it was entirely experimental and not satisfactory as an experiment by any means.

Q. What do you mean by 'bad shape' of your mill?

A. Well, our machinery was not adapted, our grinding machinery was not adapted to the work we wanted to do.

Q. Did Hyde have anything to do with your grinding machinery?

A. I beg pardon?

Q. Did Hyde have anything to do with your grinding machinery?

A. No, he did not."

And there you will find it, if you want the reason why the mill was closed down and shut. It was not because of Minerals Separation.

Let me call your attention to one other thing. When I asked Mr. Hollister on cross-examination what oil he was using, and whether he was using less than 20 lb. of oil to the ton of ore treated, he declined to answer, he declined to answer that question, as many other of the witnesses declined to answer the same question. Now, gentlemen, either there was infringement or there was not. If this matter is to be handled in a big broad open fair and honest way, a man does not mind the question as to the amount of oil he is using. If he is not infringing, he does not care. I want to say for some, that with courage and fearlessness they mentioned what they were doing

and what they were using. Even though Mr. Hollister was told that no testimony that he would give would be used against him in any proceeding in the future, he declined to answer and yet we are told that when we have Mr. Henry D. Williams write a letter to the Evergreen Mining Co. and others to stop infringing, we are threatening them, we are coercing them, we are abusing them, and we are doing things which the law condemns. If we did all these things, here was the chance and the opportunity on the part of Mr. Hollister at least to prove beyond doubt that at any rate, so far as our letter to him was concerned, it should not have been written. Why was it written? Because the Patent Law says, as I understand it, that if you learn of infringement you ought to give notice of some kind to the infringer of your rights.

I am somewhat limited in what I can or want to say. As Mr. Montague put it this morning, pointing to the many volumes of testimony, "there is only a part of the record and more is to come". Our side has not yet been heard from, and I cannot tell you everything. I can try to tell you a few things. There is one situation however I will not be able to discuss, and that is the patent situation. I am not a patent lawyer, nor do I think that arguments pro and con between the lawyers on each side, or the submission of patent questions to the Mining Congress, can bring forth anything useful unless it be with a view to determine first what each claims. I shall not speak of patent law, if for no other reason than that the various matters are before the courts, and so far as I am concerned, they are in the hands of patent counsel, and I do not think it would be correct or proper for me professionally, to discuss a situation which, as lawyers put it, is *sub judice*.

I do want however to make one comment, subject to correction by my company or the patent lawyers, should I be wrong. I speak of it now because I notice it interested Dr. Cottrell, as it very properly should. I understood Mr. Montague to say that if any particular company is using the oil patent, 835,120, that when that patent expires in 1923, and a licensee of Minerals Separation uses no other of its patents, that, nevertheless, beyond 1923, the expiration date of the patent, Minerals Separation claims the right to continue to exact royalties from its licensees, until the crack of doom, or as he more nicely put it, as he always does: "Until the end of time." I may be wrong, and the question as to whether I am right or wrong can properly be determined and easily upon inquiry, and will be determined. That is not my understanding. In other words, if when 1923 comes, and a licensee does not use any of the Minerals Separation patents at all, I do not understand that he must pay any royalty to Minerals Separation. If, when the 1923 patent has expired, and he uses any other patent, let us say the soluble frothing agent patent, then his royalty continues. If he ceases using it, he pays no royalty. No licensee is called upon to pay any royalty unless he uses a Minerals Separation patent within the period allowed by law. Please let it be known by the

members of the Mining Congress that it is my understanding, subject to correction by Minerals Separation or its patent attorneys, that when the 1923 patent expires and a licensee uses no other patent, he pays no royalty. If he uses our 1927 patent, or any other, then, being a licensee, and using our patent, he must pay royalty. If when 1927 comes and he does not use any of our patents, why then, of course, as I understand it, and subject to correction as I have stated, we cannot exact or ask or claim any royalty from our licensee. I say that because I feel that when the patent expires and it is not protected any more, it is open, and I cannot conceive, or better, I cannot understand how the contention arose. When I say I cannot understand, it may be, and it is possible, that my understanding on this patent matter is entirely wrong. Whether I am right or whether I am wrong however the Mining Congress and the public, are entitled to know what our attitude as to that is. I have stated to you what I understand it to be, subject to correction.

You listened patiently, as I did, this morning, to the reading of a great many extracts from a license agreement; and yet, gentlemen, why the old license agreement of Minerals Separation, abandoned in December 1917, should furnish the gravamen of charges made against us, is absolutely beyond me. There is no justification for referring to our old license agreement when we have a new one which has eliminated from it a great many features which were criticized in one of the addresses of this morning. I will discuss with you why the provisions were in the old license agreement as they were, because there was some reason for it. Since December 1917, however, there has never been a time under our license agreement, when a manufacturer of a flotation machine could not sell his flotation machine to any licensee of Minerals Separation Company. All we require is that the licensee should ask our consent to its purchase. You may say: "Well, you didn't have to give your consent if you didn't want to." Our new license agreement specifically says we *must* give our consent. That eliminates from the situation the question whether any maker of a flotation machine can sell his machine to any licensee of Minerals Separation. In other words, if the John Jones Mining Company wanted to install the Ruth machine or the Grouch machine, or the K & K or the Janney machine, or the Callow cell—the John Jones Mining Company need only ask us and we are obligated to give our consent. We merely state that we do not hold ourselves responsible for anything that may happen by reason of the use of somebody else's machine. Let me show you the way that works. A little while ago there was sent by the Pneumatic Process Flotation Co.—I believe that is Mr. Callow—to the mining fraternity, a statement that the company were owners of a certain machine, and so forth, and controlled certain patents, and that anybody using that machine and so forth, infringed the patent, and they were going to hold such a one liable for such damages as were allowable by law for infringement. We received a letter from

a licensee in Boston, sending us a copy of this particular statement telling us that it was not going to pay any more royalty, and that we were called upon, under our license agreement, to defend against any suit that the Pneumatic Process Flotation Co. might bring. Now that is why, when our consent is given, we say we will not be responsible for anything that may happen by reason of the use of somebody else's machine.

I am not trying to sell or advertise the standard machine of the Minerals Separation. Whether you have it or not is a matter of indifference to me. I do want to state this, that if a mining company had been using a Minerals Separation standard machine, we would then have defended our licensee against a suit brought against our licensee by the Pneumatic Process Flotation Co. if the charge was made that our machine infringed upon the process or machine claimed to have been owned by the Pneumatic Process company.

Reference was made to the license agreement, I think it is Section 3, and it was stated we had demanded or claimed or insisted that the employees of all of the licensees *had* to assign and transfer to Minerals Separation whatever they invented. Now, gentlemen, that is also the old license agreement; that clause is not in the new license agreement. I will read from the license agreement. The third article reads as follows: "Licensees, shall, during the continuance of this license"—and I do not say that so far as the licensees are concerned that the licensees are not obligated to transfer their patents—that is quite correct—but I am discussing the question of their employees, and I will tell you why later, why the licensees are called upon and the employees not—"Licensees shall, during the continuance of this license, promptly communicate and explain to licensors every invention or discovery made or used by them which may be an improvement, modification or addition to any of the inventions specified in the letters patent within this license, or may be useful in carrying out any of the processes thereby perfected, or any additions thereto, or modifications thereof, whether patentable or not." It then reads that the licensees will use their good offices to induce their officers, agents, and employees, to assign or transfer to the licensors any inventions made by such inventors upon terms mutually satisfactory to said licensors and said inventors. As I said before, the officers, agents and employees of the licensees who invent or discover, are not obligated to turn over to Minerals Separation their discoveries, if made as individuals; and to prove to you that this has not borne heavily on the mining industry, I should state that there has not been one single patent of Minerals Separation ever obtained from any licensee. There were two or three patents, it was testified to before the Federal Trade Commission, which were obtained from employees of licensees.

They were purchased however by the Minerals Separation Company, and in one instance where one of the employees demanded of Minerals Separation a price in excess of that which Minerals Separation thought proper

or fair the employee sold his patent to somebody else. That is the length and breadth of this story. Now, do not misunderstand me. We were asked quite recently by an intending licensee who, incidently, was a witness against us in the Federal Trade Commission proceedings, but who listened to the testimony and evidently had his mind disabused of some of the things that had hinged in it, for an interpretation of this clause of our license agreement. This was written to him and may be regarded as having been written to you.

"In compliance with your request we are pleased to confirm what we said to you the other day at our conference with respect to our interpretation of those portions of Section three of the license issued by us which, assuming the licensee to be a corporation, you thought conflicting. The first part of section three seeks to cover patents acquired by such corporations, or of which the corporation becomes the outright or beneficial owner. The latter part of Section 3, namely, that referring to officers, agents and employees, applies to them as individuals, and what they do as individuals, as separate and distinct from what they do as officers, agents or employees of the corporation. What the officers, agents and employees invent or discover as individuals, and not as officers, agents or employees of the corporation, is their own property, unless it be that by agreement with the corporation they are obliged to turn over to the corporation that which they, as such individuals, invent or discover. All agreements, and the conduct of the parties thereunder, must be measured by good faith, and where good faith actuates the parties there ought to be little opportunity for controversy."

Now, I mention to you that we are now obliged to give our consent to the installation of any machine to work the flotation process. At the very foot of Section 3, from which I read are the following words:

"On written request, consent will be given by the licenser who, however, assumes no responsibility or obligation whatever by reason thereof."

At one of the proceedings here in Denver last summer, and it was almost as warm then as it is getting to be in this room, Mr. Ruth took the stand, and he complained, of course, that we interfered with him and said the things that you heard mentioned this morning. I asked him: "Mr. Ruth, don't you know that you can sell your machine and could sell your machine at all times subsequent to December 1917, nearly three years ago, to any licensee of Minerals Separation?" And he said, he didn't know anything about it. Strange, with our license agreement out, with this article of the Mining Congress written last year and extensively distributed, that he didn't even know he was free to sell his machine to whomsoever he wanted.

There is always one question involved, and I want to explain it, if I can, because it has been explained to me by the patent lawyers, and I will say that such examination as I have made of that particular matter confirmed the advice given. We are criticized because we were hesitant, up to a certain time, about giving our consent

to the use of, or permitting our licensees to use the K & K machine, or the Janney, and also because in the contracts we were negotiating, let us say with the Stimpson Equipment Co., or any of the others, we insisted that they should not sell their machine to any but licensees, and that they could not sell their machines to infringers of our process under penalty of, I believe, ten thousand dollars. Let me explain to you. It has been stated time and again that if a machine is sold by the owner or inventor to some one else, for the purpose if you please, of working a certain process which the machine is designed to work, and which process is covered by a patent which belongs to some one else, the inventor of the machine which is used to infringe the process becomes a contributory infringer. Now, that is as clear as can be, and that is why Minerals Separation, in view of the long extensive and expensive patent litigation it has had in this country, steadily since 1911, had to protect and guard itself, and it could not agree that a manufacturer of a machine designed to work its process could sell his machine to an infringer, and Minerals Separation was advised at that time to protect itself accordingly. Also, when Minerals Separation first came over here people did not cotton to its process with the regard and affection that a parent bestows upon a child. A number of people used it without success. We were rather anxious to make a success of the process in this country. Failure of our process meant failure to us, and we naturally husbanded and kept together everything that we had which we knew would work the process so that we could get and deserve the name and the reputation of being able to save from waste, metal values which theretofore had gone to waste. When, however, our reputation was finally established, and not the reputation, if you please, you gentlemen of the Mining Congress have sought to give us, but the reputation of having been responsible in a great measure for much of the success of the Anaconda Copper, the Inspiration, the Calumet & Hecla and others—when it was known we had something worth while to take under the license or to steal by infringing, when we had established the value of that which we claimed we had, we withdrew many of the restrictions that theretofore we had used and employed. Now, I do not think it of moment or important at all from the viewpoint of the present or from the viewpoint of the future, to discuss or argue with you gentlemen, or with your counsel, whether some of the restrictions that we had in the past were improper, or vicious or grievous, or any of the other adjectives used against us by counsel, in the Federal Trade Commission proceeding—these restrictive covenants are over the dam. If the Federal Trade Commission want to bring them in as proof of methods or conduct on our part in the past, strength to their elbow, say I, but I am here talking to the members of the American Mining Congress today of the situation as of today, and if anything that I say, can clear up or explain in your mind doubts which exist, doubts as to the policy pursued, doubts as to what your rights are, of course, I will be glad. I will certainly try to. I say to

the members of the American Mining Congress in connection with our license agreement, in connection with our patents, and in connection with anything we have, that the doors of the Minerals Separation have been open and are open to any member of the Mining Congress or the mining industry, or, for that matter, to anyone else, entering its doors in good faith whether to become a licensee or to get information respecting the license agreement or with respect to anything else. I know we have made various enemies in the past. Wherever I have been in the West I have seldom heard anything said pleasantly or kindly. There have been times when I have had the opportunity to talk over or explain our situation, and the reasons pro and con, where we have made a friend, and some of the witnesses, as I said to you before, who testified against us in this Federal Trade Commission hearing, seeing the light of day and having had explained to them the situation in plain, simple Anglo-Saxon, as to what was what, have honored us by coming to us and desiring to become licensees. I say "honored" because when you can make a friend of an enemy, when the method you pursue turns an enemy into a friend, because he believes you are right, I think it is something of a privilege.

For six hours the representative of the Alien Property Custodian and I went through the files almost as ominous looking as the blue records on the table. When he spoke and said something about the "oppression of the mining industry" I said that I would like some governmental agency properly functioning learn there was nothing to his charge of "oppressing the mining industry", and I said, as I say to you, "I have heard this until I am tired".

Fortunately, Mr. John Ballot put in writing the answer to that question two years ago and with your permission, because it is in evidence in the Federal Trade Commission proceedings, I would like to read what he said as showing "the attitude of Minerals Separation towards the mining industry". It is dated the 28th of September, 1918, before the institution by the Federal Trade Commission of its proceedings and written more than two years ago.

"In response to Mr. Kresel's verbal request for a short statement giving our side of the case, stating that he had so far heard only the representatives of the other side, I will endeavor to give a brief summary of the actual facts, which may help him in the investigation of the charge of the alleged 'oppression of the mining industry', which you tell me he has advised you he has been requested to make. I begin with a short historical sketch.

"Leaving out the question of title for the moment, it is an undisputed fact that we were the first to introduce the air-flotation process in this country.

"Air-froth flotation and its practical application were totally unknown before we introduced it.

"The gravity method, or what is commonly called the method of concentration by water, was the only commercial process in general use for dressing or concentrating the values from certain low-grade ores, until the introduction of the flotation process.

"In March or April 1911, one James M. Hyde, an engineer, who had been in our employ until February 1911, and who, during his employment with us, had been specially instructed in the practice and application of the air-froth flotation process, approached the Butte & Superior management and induced them to adopt the use of our flotation process and take the risk of disputing the validity of our patent in the courts. It would take too much space to go into the detail here of Hyde's record in this connection. We therefore refer Mr. Kresel for a full account of it to the Butte & Superior Supreme Court record. From the foregoing it will be seen that Mr. Hyde, a former trusted servant, was responsible for our first lawsuit.

"Lest it should appear that the management of the Butte & Superior Co. entered into an arrangement with Hyde in ignorance of the facts, and unmindful of the consequences of the unlicensed use of our flotation process, it should be said at once that we gave the Butte & Superior management due and timely notice of the true position and of our claims to the process and expressed our desire to meet the management in every reasonable way with a view to negotiating a satisfactory arrangement for the licensed use of the process. They, however, questioned our rights, refused to negotiate with us, and proceeded to use the process without license. Their adoption of this attitude forced us to seek relief in the only direction possible, and it also injured us in several ways:

"First, because of their inexperience, the process when installed and put in operation in their mill worked with indifferent success for a considerable time. The reports of their bad results were disseminated abroad with the consequence that other mine owners were deterred from adopting the process. For corroboration of the foregoing statement, we refer to the evidence given by Frank G. Janney, chief metallurgist for the Butte & Superior Co. in the Miami case. (Citations and references to Record and Exhibits omitted.)

"In time, we were successful in inducing ex-Senator W. A. Clark and Mr. M. N. Atwater to take licenses from us, erect plants and operate them under our supervision. The results were highly satisfactory and demonstrated that the best economical results obtainable by the process depended in great part on the installation of suitable plants and on proper operation by men acquainted with the process.

"Secondly, the fact that a most important group of mining interests, known as the Jackling-Hayden Stone interests, who besides controlling the Butte & Superior, also control or manage, among others, the well known great mines of the Utah Copper, Ray Consolidated, Chino Copper, and Nevada Consolidated companies, was disputing our title to the flotation patents made it well-nigh impossible for us at first, and for a considerable time to induce any of the outside mine owners in North America to adopt our processes under the license on any terms. I need not enter here into the history, duration, and cost of this Hyde-Butte & Superior and other litigations. Suffice it to say that two of the suits are still

sub judice. The present status, as I stated to Mr. Kresel, is that in the Butte & Superior case we have applied to the Supreme Court for a writ of *certiorari* for the purpose of getting a final adjudication as to the extent of our rights to air froth flotation, on a patent already declared valid by that court."

I turn now to the complaints said to have been made by anonymous people that we are hampering the mining industry and preventing the output of metals. We feel at a disadvantage, which must be at once recognized, because of the difficulty to meet a vague undefined indictment of which no particulars are given us and no specific charges indicated; nor do we know the accuser, who appears to be hiding behind the veil of anonymity, apparently unwilling to come forward and make the charge openly.

While anxious to meet any charge and give all information, we are, of necessity, unable to give any definite reply or make any answer except in a general way; but we give the assurance that if our accusers will formulate definite charges we will undertake to reply in detail to every point raised or every charge made.

In the first place, we think we may safely put the so-called Jackling-Hayden Stone and Miami groups out of the discussion. They have no right of complaint. They and their shareholders have received large profits in distributions of proceeds earned for them by their infringing use of our process. By their own election they have brought it about that their action and their companies' interests are being dealt with by the courts of the land and until final adjudication nothing more need be said about them.

Even in their case, in which we have been most wronged, if the one pertinent question were asked: Whether we had in the past, or pending proceedings for final adjudication, done anything to restrain or hamper their production of metal, we could decidedly and without fear of contradiction declare that we have not done so either directly or indirectly.

We might have acted otherwise. We might have taken full advantage of our right, and legal position to issue injunctions and compel them to cease the unlawful use of our process or close down their plants unless they complied with our rights. We have, however, done no such thing. They have been left free to operate their plants as they would, so as to insure their securing the best results and largest output of metal, without any interference from us, and they have not been slow in distributing and so dissipating the enormous profits derived by them from the illegal use of our patents.

Now, as to the remaining mining interests, we have already stated that the other important mining groups are our licensees, together with many other smaller mining companies, numbering some 103 active and prospective producers. Those operating are doing so with great profit to themselves, and are using the process under best conditions to yield the fullest advantage without any hamperings or hindrances whatever.

There, then, remains to be considered such mine own-

ers as have been using our process without license, and others who have not adopted flotation at all. We believe there are some 450 such unlicensed users, and to many of those we have sent notices with schedules of rates of royalty (reference to exhibits omitted), informing them that we are prepared to grant them licenses at any time, upon their making adjustments for past unlicensed use of the process. Some have responded to our notices and have compromised for their past unlicensed use of the process and have taken out licenses, and so far as we know they are well satisfied. Others of the 450 unlicensed users have disregarded our notices and invitation. We have, however, so far done nothing to hamper their operations and profitable use of our processes, although they have arbitrarily taken our property and used it because its use brings them great profit out of what had been waste and loss before.

As we understand it, we are bound legally, to protect our rights, and were advised that it was our duty to send the formal notices to unlicensed users. Beyond sending these we have so far done nothing to restrain or reduce their output of metal. Even though legally we have the right to issue injunctions we have in no case taken such a course, although common justice demands that the unfair use of our property and unfair competition with our licensees ought not to be permitted to go on indefinitely.

Those who have so far not adopted flotation can at any time obtain a license from us, on request. It has been and continues to be our policy to meet every case fairly and squarely, taking into consideration the special conditions which obtain in each case. We have spent much time and thought in developing various schedules of royalty to meet general as well as special cases and classes of ores and metals, and we are always willing to discuss or consider special cases or suggestions.

I was asked what I thought should be done, and I will tell it to you. I think, perhaps, if the American Mining Congress undertook through its directorate, to appoint a committee of men in the mining profession, men of character—and you have so many—unbiased and judicially minded, and told them to take up with us, and we are always ready to take up and discuss and explain the various problems that they think are oppressive to the mining industry, we will be very glad to sit down with them, and we will be very glad to confer with them; and it may very well be that much in the way of misunderstanding and delusion will be dissipated. Go ahead with all your proceedings at the same time, if you want, I don't care, but I am thinking of something bigger and broader than litigation: I am thinking of something bigger and broader than success, either success for me, or success for the Mining Congress. I am thinking of the mining industry, which means much to Minerals Separation, and to which Minerals Separation means much. I am thinking that we should once and for all sit down in a calm, judicial, dispassionate way, determine what is right, and what is fair, and if that is done, truly the mining congress is an American Mining Congress.

The Geology of the Portland Canal District

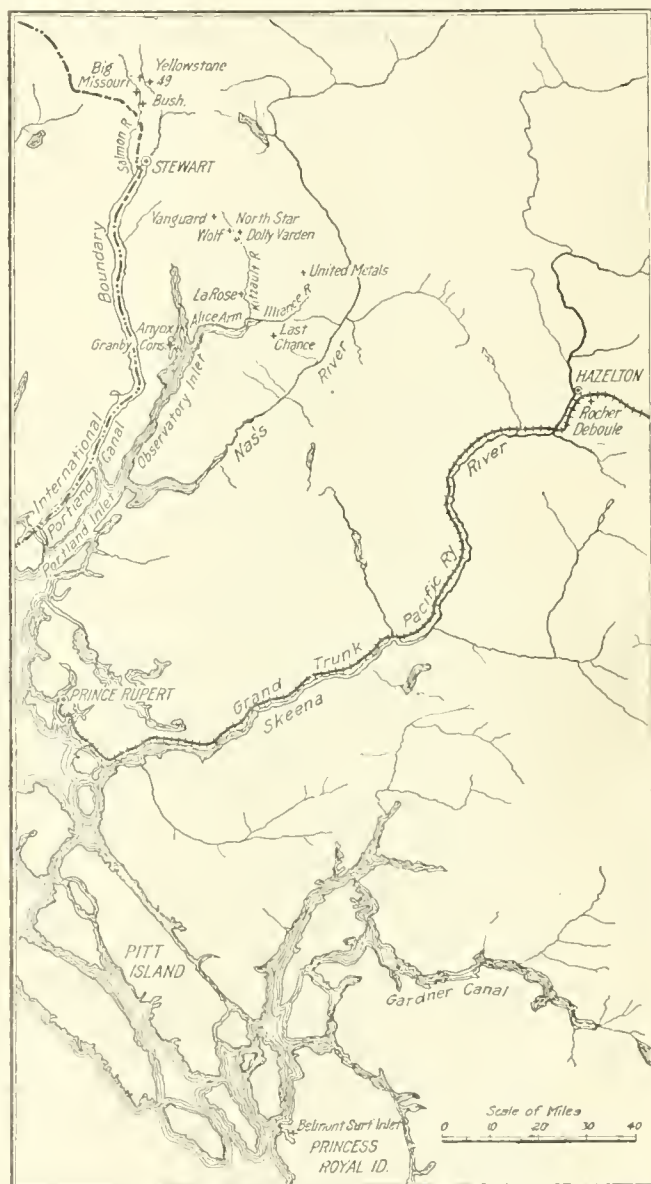
By Victor H. Wilhelm

The Portland Canal mining district covers a portion of the Coast range extending from the head of Portland Canal up the Salmon and Bear rivers. The district is bounded on the west by the granitic uplift of the Coast range. The oldest formation in the Salmon River district consists of a series of volcanic tuffs and breccias, called, by R. G. McConnell, the Dominion Geologist, the Bear River series. This series is overlain by the Nass series of argillites and tuffaceous conglomerates, and is intruded by large sills and tongues of quartz-porphry, which are intermingled with volcanic agglomerate. During the Jurassic period occurred the granitic uplift of the Coast range, coincident with and subsequent to which the whole area was intruded by a series of granitic and porphyritic rocks, in stocks and dikes, as spurs and offshoots of the granitic magma. Subsequently, during a period of readjustment, probably during the Tertiary period, the area of quartz-porphry and breccia was sheared and mineralized by ascending solutions from the dying batholith. Subsequent to this primary mineralization, the entire district was intruded by small irregular dioritic dikes, which cut but do not interfere with the continuity of the mineralized shear-zones. The quartz-porphry has been altered and silicified and has a marked schistosity, the direction of which governs the ore-zones. These consist of a shattered area filled with reticulating quartz veins and stringers. The metallic sulphides are disseminated through the quartz-porphry as well as the quartz veins. Erosion throughout this area has been very great, and the primary sulphides outcrop on the surface, presenting the appearance of lenticular lenses or blankets of truncated orebodies.

The Premier mine, situated 14 miles north of Hyder, Alaska, in the Salmon River valley, is the only large developed property in this entire district. The orebody consists of a shear-zone in quartz-porphry trending N. 80° E. and S. 80° W., with secondary mineralization along the fault-planes or step-faults bearing NE. and SW. High-grade ore occurs along this secondary fissuring and at the intersections of the shear-zone. The main orebody consists of irregular lenses within the highly silicified quartz-porphry, and averages 1000 ft. in length and 80 ft. in width. A considerable amount of high-grade shipping ore, consisting mainly of argentite, has been found along the hanging-wall side of the shear-zone. Besides the shipping ore, the mine contains a large body of low-grade complex sulphide milling-ore contained mainly between the step-faults.

The Missouri group of claims, situated 17 miles north of the head of Portland Canal, in the Salmon River basin, consists of an immense residual sulphide orebody covering a surface of over 40 acres, being over 1600 ft. long, and in places over a thousand feet wide. The formation

consists of volcanic tuffs and scattered fragments of slate deposits, intruded by large masses of schistose quartz-porphry. Numerous large dikes of fresh quartz-porphry and granite coming from the large batholith of granite, which lies a few miles to the west, cross the area



THE 'BUSH' MINE, AS SHOWN ON THE MAP, IS THE SAME AS THE 'PREMIER'

and seem to have considerable influence on the orebodies. Diamond-drilling has shown this primary sulphide orebody to be a residual surface sulphide zone. The following is an analysis of an average sample of this ore: gold, 0.03 oz.; silver, 2.3 oz.; lead, 2.5%; zinc, 5.2%; copper, 0.6%; iron, 14%; insoluble, 59%. This indicates galena 2.5%, blende 7.6%, chalcopyrite 1.55%, and pyrite 29.3%. Simple concentration gives the ratio of 2.7:1.

On a slide, adjacent to the Salmon River glacier, on this property, there is over a million tons of ore of the above grade already broken. This property would not need depth to make a mine because of its large surface area. On the E. Pluribus and Laura claims, north east of the primary low grade sulphide orebody, there exist some high grade surface showings. These orebodies occur in lenses along step faults at right angles to the general trend of the shear-zone. The Joker claims on the east show the same characteristic high grade surface ore-lenses dying out at a shallow depth.

The Spider group, under bond to the Algonquian Development Co. of Brussels, Belgium, situated three miles north-east of the Missouri group, consists of a shear-zone in which small high-grade veins intersect an older group of large low-grade quartz veins in an intrusive mass of augite-porphry. Over 700 ft. of lateral development along one of the small veins has exposed several shoots of shipping ore, and considerable enrichment is looked for at the intersection of the shear-zone with the large low-grade quartz veins. The ore consists of a complex sulphide, analysis of which is as follows: zinc 9.37%, silica 62.25%, copper 2.92%, lead 5.2%, silver 1.98%, iron 5.2%, aluminum and sulphur 13.68%. The orebodies seem to have considerable persistence in depth, and will probably develop into a small mine. This property will ship 500 tons of high-grade silver ore this winter.

The Bear River valley in this district was the scene of a boom about ten years ago, and several properties of decided merit were developed in the slate area. At that time the district was more or less discredited by the exploitation of a few properties of doubtful merit. The orebodies consist of large irregular complex sulphide orebodies in lenses or shear-zones in slate. The development of ore-reserves in ground of this character is very difficult. At the present time there is considerable mining activity in the breccia and tuff area of the Upper Bear River valley. The orebodies consist mainly as large lenses of chalcopyrite containing gold and silver. The surface exposures are large, and with continuity in depth the properties would be able to develop immense ore-reserves at slight cost. The Comet, Rufus, and George Copper are the principal properties. The Red Top in this district has a large outcrop of galena in the same formation. The properties are fairly accessible, owing to the fact that the dilapidated line of the Canadian North-Eastern railroad runs up the Bear River line for a distance of 14 miles.

Provided that a considerable tonnage is developed, the Portland Canal district offers no great difficulties to successful mine operation. The mineralized area is from 12 to 20 miles from tide-water, and railroad construction would not be difficult. The area below the 2500-ft. line of elevation is densely timbered, and summer water-power can easily be developed for from five to seven months, but storage-basins for the development of winter power are scarce. The rich ores can be smelted, but the low-grade ores will require considerable experimentation before a successful milling process is developed.

Permissible Explosives

An explosive is called a permissible explosive when it is similar in all respects to the sample that passed a certain test by the Bureau of Mines, and when it is used in accordance with the conditions prescribed by the Bureau. But even the explosives that have passed these tests and are named in this list as permissible are to be considered permissible explosives only when used under the following conditions:

1. That the explosive is in all respects similar to the sample submitted by the manufacturer for test.
2. That detonators—preferably electric detonators—used are not less efficient than those prescribed, namely, those consisting by weight of 90 parts of mercury fulminate and 10 parts of potassium chlorate (or their equivalents).
3. That the explosive, if frozen, shall be thoroughly thawed in a safe and suitable manner before use.
4. That the quantity used for a shot does not exceed 1½ lb., and that it is properly tamped with clay or other non-combustible stemming.

After an explosive has passed the required tests and its brand name has been published in a list of permissible explosives, it is not a permissible explosive if one or more of any of the following conditions prevail:

1. If kept in a moist place until it undergoes a change in character.
2. If used in a frozen or partly frozen condition.
3. If used in excess of 1½ pounds per shot.
4. If the diameter of the cartridge is less than that designated 'smallest permissible diameter'.
5. If fired with a detonator or electric detonator of less efficiency than that prescribed.
6. If fired without stemming.
7. If fired with combustible stemming.

Moreover, even when all of the prescribed conditions have been met, no explosive on the permissible list should necessarily be considered as being *permanently* a permissible explosive, for the Bureau reserves the right, on fuller information concerning the conditions that lead to safety, to revise this list; but any permissible explosive when used under the prescribed conditions may properly continue to be considered a permissible explosive until notice of its withdrawal or removal from the list has been officially published, or until its name is omitted from a later list published by the Bureau of Mines.

No gold was produced from quartz or placer mines in North Carolina in 1919, and at only one deep mine, that of the Rich Cog Mining Co., at Eldorado, Montgomery county, was any development work done. The value of the gold produced in North Carolina during the period 1799 to 1918 was \$23,628,413. In 1915 the recovery of gold amounted to \$172,001, but in 1918 it decreased to \$1631, which, with 17 oz. of silver, was derived from placer mines or old mill clean-ups. Increased costs of mining and milling the low-grade gold ores and gravels have made operations unprofitable.

California's Metal Output in 1920

*The outstanding and unprecedented feature of metal mining in California in 1920 was the closing down of a great number of the largest gold and copper mines, and the conditions generally have been decidedly adverse, particularly in the Mother Lode region, where some of the mines that were once among the largest in the State have stopped work, several of them permanently. Both the Kennedy and the Argonaut mine, at Jackson, Amador county, were closed, mainly on account of trouble with fire and water. Other lode mines that stopped work were the Keystone, Utica, Gold Cliff, Eagle-Shawmut, and Tightner. The smelters of the Mammoth Copper, Mountain Copper, and Penn Mining Co., usually among the largest producers of copper in the State, remained shut-down during 1920, and the Walker Copper Co. closed late in the year. The Afterthought Copper mine, in Shasta county, was active for the first two months, when both mine and plant were closed. Another feature of the year was the restriction of the supply of power by hydro-electric companies in the fall, which affected the deep mines of all classes as well as the dredging companies. For lack of this usual power some mines had to close altogether and others were compelled to restrict operations. When the first fall rains commenced, in October, the supply of power was at once restored. The hardships suffered by the gold miners in the foothill and mountain counties have partly depopulated towns and camps and even counties. Numerous mines are being allowed to fill with water, and some reduction plants have been virtually abandoned.

The labor available in the mining regions of the State is reported to be still unsatisfactory, and its high cost and inefficiency have been the principal causes of the closing down of many large mines and of the curtailment of operations in others, although other high costs have contributed to reduce production. Prospecting has been almost stopped in the older mining regions, and very few large mining enterprises have been started. In fact, it is difficult or almost impossible to obtain capital for gold mining, as few miners are making a profit. Some large producers are unwilling to push production and development and pay the consequent war income tax, so they are only keeping the mines running. The force of men engaged in all kinds of mining work has been cut down. The cost of producing gold has been steadily rising for several years, until it nearly prohibits all profit.

Without the dredging industry of California, gold mining in the State would be at low ebb, for the adverse conditions have more strongly affected lode mining than placer mining. Of the total gold produced in the State in 1920, 52% was obtained from deep or lode mines and 48% from placers. The dredges are producing 96% of the placer gold, or 46% of the gold output of the State.

There seems to be a small continuous decrease in the percentage of gold produced by the deep mines and a corresponding increase in the percentage produced by the placers. Of the gold produced by deep mines the larger proportion is derived from silicious ore, but some is derived from copper, lead, and zinc ores. The dredges have been increasing their proportion of the total output of gold, but the hydraulic, drift, and sluicing mines are steadily decreasing their proportion. Since the dredges began work in California, in 1898, they have dug out about \$120,000,000. Though some of the smaller and more isolated placer fields have been worked out, new placers have been found, and the larger fields, except that at Oroville, are showing an increased output annually. About 45 dredges, some of the very largest size, are now in operation in California.

Although gold has been mined in California for more than 70 years, it is still produced by 32 of the 59 counties of the State. Yuba county, in the early days famous for its hydraulic mining and afterward abandoned for more than 30 years as a mining field, is now the leading gold-producing county of the State, its output exceeding by over a million dollars per year that of the most productive deep-mine county. This revival and increase of production is due entirely to dredging, which produces 99% of the gold output of the county. The ground now worked by the dredges is not only covered with debris from former hydraulic mining, but is too low and carries too little gold to be mined profitably on a large scale by any other system than dredging. A few new dredges were set to work in 1920 on fields in California outside of Yuba county, and several stopped work. One of the new operations is that of the Yankee Hill Dredging Co., in Stanislaus county, between Oakdale and Knights Ferry. Another, operated on a new plan—a 'dry-land' dredge—is in the Noce placer holdings, in the eastern part of Calaveras county.

The output of silver from mines in California was about 1,538,660 oz. in 1920, an increase of 431,471 oz. over that in 1919. This increase is somewhat surprising in view of the fact that the largest copper smelters in the State were closed down during the year, for a considerable part of the silver produced is usually obtained from copper ores. But there was an increase in the output of lead and lead-silver ores in southern California, with consequent increase in silver from those sources. Moreover, the California Rand mine, in San Bernardino county, continued to ship high-grade ore during the year, making a material increase over its normal output.

The estimated output of copper in California in 1920 was 12,934,900 lb., as compared with 21,732,507 in 1919, a decrease of 8,797,607 lb. The Mammoth Copper Co. and the Mountain Copper Co., of Shasta county, and the Penn Mining Co., of Calaveras county, kept their smelters closed throughout the year, and the Walker Mining

*Advance estimates by Charles G. Yale, San Francisco office of the U. S. G. S.

Co., of Plumas county, stopped production for several months. These facts account for the decrease in the output of copper in 1920 in California, for the mines mentioned are among the most productive in the State. Smaller properties throughout the mining region also stopped producing copper ores, owing to the low price of the metal and adverse general conditions.

The estimated output of lead in 1920 is 5,071,600 lb., an increase of 1,503,333 lb. over the output in 1919. This increase is due entirely to the production of one mine in southern California that reported no output in 1919. Moreover, a number of lead and lead-silver properties, mainly in San Bernardino and Inyo counties, began or increased production in 1920. Nevertheless the output of lead in California is still far below the normal, as that in 1918 was over 13,000,000 pounds.

The zinc output of California in 1920 is estimated at 1,522,500 lb., or 1,099,029 lb. more than in 1919. Zinc was produced at only a few mines in the State, all in Inyo county.

Among the newer operations in hydraulic mining in California is the completion of the debris-restraining dam of the Elephant hydraulic mine, near Volcano, Amador county. This dam is 30 ft. high and 425 ft. long. Not many new dams of this kind were built in California in 1919, as few hydraulic mines have been opened and equipped. The old Curtz Consolidated mine, at Markleeville, Alpine county, has been sold, and the new owners are repairing the old workings and arranging to resume operations. The Monitor, also in Alpine county, has been shipping some ore. A new 10-stamp unit has been added to the milling plant of the Carson Gold Mining Co., in Calaveras county, giving it a capacity of 15,000 tons per month. The old Cherokee mine, near Oroville, Butte county, once a famous hydraulic property, is to be re-opened. The channel of this mine runs under Table mountain. The El Dorado Exploration Co., Eldorado county, has discarded its steam-power plant at both mine and mill and has installed an electric plant. The North Star Mines Co., at Grass Valley, has stopped the use of its costly tramway and uses an electric locomotive and self-dumping cars to remove mill tailing to a new storage basin, built to receive it. The old Delhi Mining Co., which owns extensive water-rights on the middle fork of the Yuba river, has put in a new hydro-electric power-plant, partly for its own use but partly to supply power to the Pacific Gas & Electric Co. for general use. At Meadow Lake, Nevada county, a mining camp that was virtually abandoned for 25 years, a cyanide plant has been put into the Excelsior mine, and some of the other old mines will be re-opened. The California Rand silver mine, in San Bernardino county, the most productive silver property in California, continued during 1920 to make shipments of high-grade ore to the smelter on San Francisco bay. The Globe and Chloride-Bailey mines, near Dedrick, Trinity county, have been purchased by New York men and are being re-opened. The Balaklala Copper Co.'s smelter at Coram has been torn down, and some of the steel and other ma-

terial obtained from it is being used in the new plant of the Shasta Zinc & Copper Co. at Winthrop, in the Bully Hill region. The Mountain Copper Co. has built a 600-ton plant for crushing pyritic ores from the Hornet mine. Although the smelter of this company has been closed throughout the year, development work has been continued in the mines. The Twenty-One Mining Co., at Alleghany, Sierra county, has sold its mining property to the Sixteen to One Mining Co., thus ending a long litigation. The Harvard mine, Tuolumne county, long owned by Boston men, has been sold to John Ferguson and associates, of Berkeley.

Copper in 1920

The smelter production of copper from domestic ores during the year 1920 is estimated by H. A. C. Jensen, of the U. S. Geological Survey, to be about 1,235,000,000 lb., compared with 1,286,000,000 lb. for 1919. The production of refined copper from foreign and domestic ores for the year was about 1,573,000,000 lb., which is approximately 195,000,000 lb. less than for the year 1919. The apparent domestic consumption was about 910,000,000 lb.; in 1919 it was 877,000,000 lb. The stocks of raw and refined copper at the end of 1920 were about 874,000,000 lb., which represents a decrease of 30,000,000 lb. from those held at the end of 1919. The total imports of raw and refined copper for the ten months ending October 30, 1920, according to the Bureau of Foreign and Domestic Commerce, were 407,437,515 lb. Exports of copper for the same period were 543,695,851 lb., compared with 516,627,775 lb. for the entire year 1919. The continued decreased production, the large stocks, and the low domestic consumption were due entirely to the generally depressed conditions of industry throughout the world, which did not permit the absorption of as great quantities of copper as had been hoped for. Low exchange and the great stocks of scrap and secondary copper available both in the United States and abroad also decreased the demand for new copper. The salient features of the copper industry during 1920 were a small hesitating demand, decreased production, continued small exports, particularly during the last half of the year, and labor troubles.

THE total value of the mineral production of Alaska increased from \$19,620,000 in 1919 to \$22,070,000 in 1920, according to estimates by Alfred H. Brooks of the U. S. G. S., just made public. This brings the value of the total mineral production of the Territory up to \$460,000,000, over half of which is to be credited to the last decade. The apparent prosperity of the Alaska mining industry during the year is due solely to the increase in the output of copper from 47,220,000 lb., valued at \$8,783,000, in 1919, to about 71,000,000 lb., valued at \$12,400,000, in 1920. Alaska has now produced 616,200,000 lb. of copper, worth \$127,000,000. As in past years, the only mines that made a large output of copper were those controlled by the Kennecott Copper Corporation, the total production of ore being 330,000 tons.

REVIEW OF MINING

FROM OUR OWN CORRESPONDENTS IN THE FIELD

COLORADO

PLANS FOR INCREASED PRODUCTION BY DREDGING.

ASPEN.—Samples of ore from the Park tunnel (said to be polybasite) have attracted much attention. The ore assayed 13,092 oz. silver. The vein is four to six feet wide and, aside from the rich streak, samples 241 oz. silver per ton. The strike was made in the Best Friend incline on Sam Houston ground and is developed through the Jenny Lind tunnel. Development of the new orebody in the Hope tunnel continues and, with the compressor connected with a motor recently secured, cross-cutting to the hanging wall and foot-wall of the vein will be completed and the width of the shoot proved. Supplies for the winter and spring have been taken into the Hurricane company's camp, where work on the lower tunnel of the Etcetera claim is being pushed. The tunnel will cut the orebody where ore was discovered before the miners were driven out by water. Connection will be made by a raise and the shaft workings drained.

BRECKENRIDGE.—Last year's recovery of gold by the dredges, which totaled \$500,000, will be exceeded this year if plans of the dredging companies are carried through. More properties are active than for many years past, and among these are the Dunkin and Price mines on Nigger hill; Quandary Queen, Mount Helen; Iron Mask, Missouri, Brooks Snider, and Deep Shaft, Shock hill; Standard, Gibson hill; June Bug, Gibson gulch; Warriors Mark, Maximus, Laurium, and Molly B. on Yuba Dam flat; Billie Junior, and Wellington. The mills of this company closed down in November, due to low zinc prices, but development continues. During 1920 the Wellington stockholders were paid \$100,000 in dividends, a total to date of \$2,000,000.

CENTRAL CITY.—The Midwest Mining & Milling Co. is making progress with mill construction at Black Hawk and the Iron City mill of the company is operating at profit and turning out high-grade concentrate. Work continues in the Midwest tunnel and a 12-in. streak of smelting-grade ore has been opened in the Peru. Work has been resumed on the National mine by E. S. Moulton and associates and ores containing gold, silver, and copper are shipped to and treated at the Rocky Mountain concentrator at Black Hawk. Machinery at the Coeur d'Alene and Isabel mines has been overhauled preparatory to the resumption of work by the National Finance & Holding Company.

CRIPPLE CREEK.—Eight sets of lessees on the property

of the Mary McKinney company, three in the main shaft, three in the Anaconda, and two sets in the Howard-shaft workings are mining and shipping medium-grade ore to Golden Cycle mill at Colorado Springs. No work is being done on company account. Cresson is maintaining production at 8000 tons monthly and building up its treasury reserve. Two shifts are employed and 120 miners are kept on the payroll.

The El Paso Extension Corporation is installing an electric hoist at the Rittenhouse shaft, Gold Hill, and has laid and connected an air-line with its compressor at the Index shaft, preparatory to development of the low-grade ore on the property.

DURANGO.—Ore from the Rico Wellington mine, averaging \$20 per ton, is being shipped at a profit to the Durango smelter as the result of a low freight-rate of \$2.50 per ton, recently put in effect. A new orebody sampling 18 oz. silver and 7 to 10% lead was recently entered and is now under development. The company last month also shipped to the smelter 500 tons of pyrite that averaged 42.5% iron.

IDAHO SPRINGS.—The Gem company has installed a 75-hp. electric hoist at the Freighter shaft, and development is under way. Machinery formerly in use at the Carr mine in Gilpin county has been purchased by the Fraction management and is being removed for installation at the Clear Creek property. A new orebody has been opened and shipments will start as soon as the hoist is in operation. The Roosevelt company at Alice is installing a new stamp-battery, while miners are breaking ore in two headings of the tunnel. A tram from the tunnel to the mill is under construction.

MICHIGAN

TAXES ON MINING PROPERTY ARE BURDENSOME.

HOUGHTON.—The mines of the Lake Superior copper region are now paying their 1920 taxes. The tax roll in Houghton county for 1920 is \$1,910,351, and it is estimated that 85% of this will be paid by the mining companies. The tax burden is considerable at this time owing to the drain on treasuries at a time of depressed metal market. The tax is based on an assessed valuation of \$91,878,050. There has been a heavy increase in mine taxes since 1916 in keeping with advancing costs, and from \$200,000 to \$300,000 has been added each year. The tax cost is particularly burdensome to companies

only in an exploratory stage. As an illustration, Mayflower has just paid approximately \$22,000 in taxes, and yet it has not produced a pound of copper. The tax account actually is equivalent to an operating expense of four months. Other mines that are not operating, but whose shares have remained comparatively high, also are hard hit. In determining the valuation of mines, the market price of the stock is the basis and the average price of the shares for the year is taken as the figure. The quotation at the close of the market every Monday for the 52 weeks of the year is totaled and the mean is the average value. The method often has been criticized, but as a matter of fact no better system has been devised and it has been upheld by the Supreme Court of Michigan. It is considered out of the question to assess a mine according to its physical valuation. Under this method, while the mines have been hard hit in 1920 taxes, assessed valuations will be considerably lower this year, as they will be based on the relatively lower market for all shares in 1920.

Removal of shaft pillars in No. 4, Wolverine, is yielding ore averaging 17 lb. of refined copper per ton. The 'rock' is selected, only that rich enough to stamp being mined. The pillars that are being taken out from the bottom of the mine upward to the 28th level, are fairly rich and uniform in copper content. The work of removing pillars has not yet started in No. 3, in which a considerable amount of ground remains to be stoped out in the old workings in the upper levels. Both drifts and stopes will be widened. There are wide stoping areas on practically every upper level that will yield rich ground and require a number of years to exhaust. Wolverine is hoisting 900 tons of rock daily and employing as many men as it can handle underground. Present costs, exclusive of taxes, are 15c. per pound.

Mohawk, which has been adding underground men from time to time, now has an efficient force, and production has reached 2350 tons per day. In No. 1 shaft, two drifts are being pushed south from the 23rd and 24th levels to connect with No. 4 shaft. The 23rd level is 500 ft. from No. 4 and the 24th is 1100 ft. The purpose of these connections is to extend the electric tramming system to No. 1 shaft, which will result in a reduction of tramming costs. Electric tramming is now in use only in No. 4. Considerable ground remains to be worked out of No. 2 and 3 shafts, both of which were abandoned some years ago, but this work will not be undertaken until all of the working shafts reach their limit in depth. There are stopes to be widened out, arches and supports to be cut away, and levels to be driven to the foot and hanging walls before the final operation of removing the shaft-pillars. The same process ultimately will follow in No. 1, 4, 5, and 6. Four heads are now in operation at the Mohawk mill and two in the Wolverine. With the new electric pump in service at the mills, a saving of 25% in fuel costs has been effected. The pumps, which supply the water for the mills, are operated by a turbine which is driven by exhaust steam from the stamp-heads.

NEVADA

CONSOLIDATED COPPERMINES STOPS WORK TEMPORARILY.

EIA.—The Consolidated Coppermines company has discharged the 60 men employed and has stopped operating, supposedly because of the low price of copper and general conditions. Last summer this company had decided to build a 2500-ton smelter and concentrator, but this work has been indefinitely postponed. There is estimated to be 20,000,000 tons of 1.33% porphyry ore, 200,000 tons of 3% heavy-sulphide ore, and 500,000 tons of 7% oxidized ore in the various workings. The Ward lead-silver mine, 12 miles south of here, has been closed because of the low price of lead. The 30 miners employed have been discharged and no further attempt will be made to operate the mine until the metal market improves. Shipments had been made for several years at a rate of 250 to 500 tons monthly and it was announced recently that the rate was to be increased to 1500 tons and then to 3000.

TONOPAH.—The Clifford silver-gold mine, credited with a production of \$500,000 since it was discovered 15 years ago, has been bonded by the Clifford estate to New York interests. The mine is 40 miles north-east of Tonopah, and during the years it has been worked by the Cliffords it has produced remarkably rich ore, most of which was treated in a small mill on the ground. In recent years little work has been done because of a disagreement among the heirs. The mine consists of 14 claims, developed through two 200-ft. shafts. Settlement sheets from the Selby smelter show, among others, the following shipments: 426 lb. concentrate assaying 7569.16 oz. silver and 38.84 oz. gold per ton; 1640 lb. ore of a net value of \$1742.76, figuring silver at 59c.; 400 lb. concentrate of a net value of \$1435.30, with silver at 48c.; 142½ lb. concentrate assaying 14,228.37 oz. silver and 226.12 oz. gold per ton. There are exposed many good shoots of medium-grade ore, including a 3-ft. width of \$38.90 ore and a 9-ft. width of \$22.40 ore. There is said to be enough \$20 to \$30 ore exposed to warrant the erection of a mill, and the holders of the bond plan to develop the mine on a good scale. Among other improvements it is planned to lay five miles of 6-in. water-pipe. The ore is free-milling.

DIVIDE.—The Rosetta, in the extreme southern part of the district, has officially reported an important find of \$20 to \$60 ore in a cross-cut driven east at a depth of 300 ft. Ore of this grade, the average value being unknown, has been penetrated for 12 ft. There have been no new developments on the 800 or 1000-ft. levels of the Tonopah Divide, where drifts are being continued south-east to reach under ore-shoots on the upper levels. A pipe-line has been completed from the Gold Reef shaft and water will soon be pumped from this source at an estimated saving of \$5000 yearly over the cost of hauling from Tonopah. The Gold Zone continues shipping from the 700-ft. level at a rate of 500 to 600 tons per month. This ore is coming from a stope and from this work is to be done to determine definitely whether the ore on the 700-

ft. level is in a fissure parallel to the main Tonopah Divide vein or is in that vein, displaced by faulting. When this has been determined it is planned to sink a winze from the 700-ft. level in the ore-shoot, which is 25 ft. long and 4 ft. wide in a vein 20 ft. wide.

MANHATTAN.—A 6-ft. width of ore has been entered 350 ft. from the shaft in the west cross-cut on the 800-ft. level of the White Caps. This ore is far east of where the main orebody should be entered at this depth. The cross-cut is being continued by two shifts of miners working under contract. In addition to this work two cross-cuts are being driven on the 500-ft. level.

HAMILTON.—Ed. Wilson and Ole Johnson, working the Great Valley silver-lead mine under lease, are hauling a carload of ore to Kimberley on the Nevada Northern railroad for shipment in the spring. Wilson and Johnson have worked the mine for the last four years, making occasional shipments to the smelter at Midvale, Utah.

PIONEER.—The Mayflower mill, in which many alterations and improvements have been made since it and the mine were taken over by the Tobin management, is being tested on low-grade ore from the main workings and the Starlight, into which a cross-cut is being driven with three shifts of miners.

STONEWALL.—Gordon M. Bettles, manager of the Yellow Tiger, estimates that after the improvements now being made have been completed at the mine and at Ralston station on the Tonopah & Tidewater railroad a saving of 40% in previous costs will be made. The company is building at the station an oil-tank that will hold a carload. This should result in a saving of seven cents per gallon and give a uniform grade of oil. Work will be resumed soon in the Sterlag tunnel.

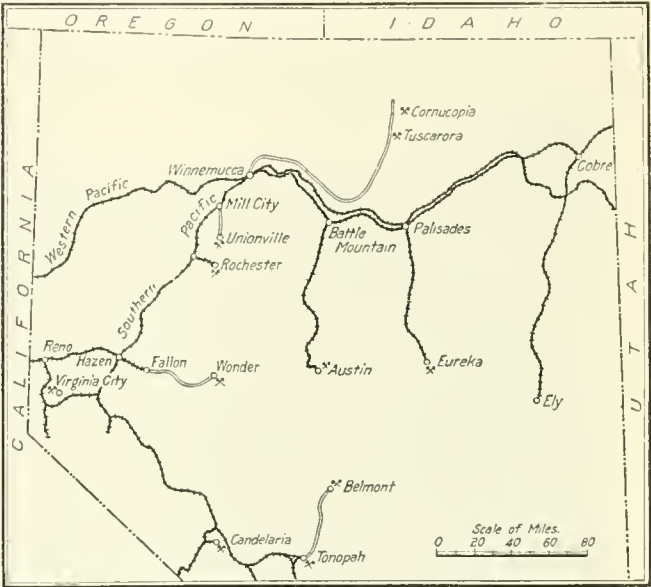
UTAH

DURING 1920 PARK CITY AND EUREKA DISTRICTS BOTH EXCEEDED PRODUCTION OF 1919.

SALT LAKE CITY.—Ernest Bamberger, general manager for the Ontario Silver Mining Co., W. Mont. Ferry, managing director for the Silver King Coalition Mines Co., and Imer Pett, general manager for the Bingham Mines Co., were representatives of Utah lead producers at the meeting of the Ways and Means Committee of Congress on January 12, 13, and 14 when the question of a tariff on lead was argued. The Utah delegation presented data to substantiate the claim that lead producers in this State cannot continue to operate unless a protective tariff is imposed on the metal. During 1920, the lead output of the State was about 134,000,000 lb., with an estimated value of \$10,939,000, so that local lead producers are naturally anxious to see the industry protected. The value of the gold, silver, copper, lead, and zinc produced in Utah during 1920 is estimated at about \$46,000,000 by Victor C. Heikes, of the U. S. Geological Survey, as compared with a value of \$45,169,328 for 1919. The output of gold and copper decreased considerably, while that of lead and zinc increased, with the silver production practically the same for both years.

PARK CITY.—During 1920, ore shipments from this district totaled 99,864 tons, as compared with 75,623 tons for 1919. The increase was due to the high prices of silver and lead prevailing during the early months of 1920, and to the opening up of several high-grade stopes in various mines. Had it not been for the slump in the price of lead during the latter months of the year, shipments would have been larger. The Judge electrolytic smelter produced 2323 tons of premium spelter during 1920, as compared with 3667 tons during 1919. The plant was closed down on November 1, due to the unsatisfactory condition of the zinc market and the increase in electric-power rate.

Preparations are under way for the installation of a large electric pump on the 2000-ft. level of the Ontario



MAP OF NORTHERN NEVADA

mine, and it is estimated that about two months time will be required to complete the work. The capacity of the new pump will be 15,000 gal. per minute. The pumps now in use on the lower levels will not be disturbed, and they will be kept in operation when necessary. The management states that there is no intention at present to sink from the 2000-ft. level.

EUREKA.—Ore shipments from this district for the year 1920 totaled 7397 cars, or approximately 296,000 tons, as compared with 6921 cars, or 276,000 tons, for 1919. As was the case with other silver-lead camps, production was pushed to the limit during the early months of the year, but during the latter months, owing to the decline in metal quotations and increased freight-rates, shipments were curtailed. During April and May, owing to the switchmen's strike, production was curtailed at all of the leading properties, owing to embargoes placed on shipments by the Salt Lake Valley smelters.

The concreting of No. 2 shaft at the Chief Consolidated mine was completed December 31. Drifting has been started on the lowest level at the property—the 1900. The shaft is the first in this State to be concreted, and while the expense has been heavy, the management feels

that the cost of repairs will be moderate as compared with a timber-lined shaft. During 1920, the Chief Consolidated established a new high record in the matter of production, 1418 cars of ore were shipped, as against 1299 cars for 1919.

It is reported that work will be resumed by the Knight interests at the Tintie Drain Tunnel property early in the new year. The tunnel is now in a distance of over a mile, and work was suspended owing to the financial stringency, some months ago. It is stated that a raise will be driven through to the surface, at a point near the face of the tunnel, and that following the completion of this work, regular driving operations will be resumed. The raise to the surface will be for ventilation purposes.

The work of enlarging and re-timbering the shaft at the Eureka-Standard property in the eastern part of the district is under way; the old single compartment shaft will be enlarged to standard size, and heavier equipment will be installed to permit further sinking. The bottom of the shaft is now at 550 feet.

Stoping has been started at the Eureka Mines property from a 10-ft. face of ore, which is a continuation of the stope mined in the Gemini property, from which shipments were made averaging 30 to 35 oz. silver and from 20 to 40% lead. At the Eureka Mines, the ore is being taken from just below the 940-ft. level, according to Jackson McChrystal, manager.

ALTA.—Four snowslides occurred upon the properties of the Emma Silver Mines Co. and the Michigan-Utah Mining Co. on January 5. One of the slides passed over several bunkhouses of the Emma company, doing but little damage. Another slide carried away the loading-station of the Michigan-Utah company, and damaged the trestle. No one was injured. Development work at the Columbus-Rexall property is proving that the mineralization in the two main fissure systems is persistent and rich, according to C. M. Evans, superintendent. Exploration work is being confined to the No. 8 and No. 10 fissure-systems. A drift has been run along fissure No. 8 for about 100 ft. At the top of the drift, five feet of high-grade ore has been cut. Both of the fissure systems make into virgin territory, and the prospect is good.

BIG COTTONWOOD.—The main working adit at the Big Cottonwood mine is now in a distance of 3268 ft. and for the last 100 ft. has been driven through a favorable formation, according to C. E. Robertson, secretary-treasurer. Stringers of sulphides and carbonates have been passed through. The objective of the adit is the Copper King fissure, estimated to be about 400 ft. distant. It is possible that the fissure has taken a slight dip in the direction of the tunnel, in which event the distance will be even less.

WISCONSIN

REVIEW FOR DECEMBER.

December witnessed the utter demoralization of the zinc-mining industry of south-west Wisconsin. In December there were no official zinc-ore quotations. When the

State Railroad Commission granted the petition of the Interstate Light & Power Co. to advance power-rates 34% some of the larger producers immediately decided to shut down. The Mineral Point Zinc Co. ordered its entire list of producers in the field, including the famous Coker, Hoskins, Penna Benton, and Black-Jack mines, shut-down, throwing 600 men out of employment. At the company's plant, in the city of Mineral Point, working schedules were reduced from seven days weekly to five days. A supply of raw-zinc concentrate on hand when the mines shut-down enabled the magnetic-separating plants and the sulphuric-acid works to continue, but as soon as this supply of raw ore, which furnishes the base for the manufacture of acid, has been treated the entire works will suspend. A few other mines have followed the example of Mineral Point.

On the other hand, at Platteville the Block-House Mining Co. operated steadily all month, selling but three cars of high-grade separator blende. It is said no shut-down is contemplated here. The two mines of the Frontier Mining Co., of Indianapolis, the Middie and Bull Moose, ran steadily on full-time schedules and by the close of the month had a reserve of 6500 tons of zinc concentrate, costing \$115,000. The Rodhams mine, a neighbor of the Frontier mines, observed the same program. The mines of the Wisconsin Zinc Co. were kept in operation all month. The first part of December found the company marketing green concentrate with the Mineral Point Zinc Co., but this expedient was soon terminated and the company's big all-steel magnetic separating plant at New Diggings, idle since August 1, was again heated up and green ore was being brought up to standard commercial premium-grade blende. The mines of the Steel & Tube Co. of America were all kept in operating shape through December, due to the fact that raw zinc ore is essential to the requirements of the company's acid plant at Cuba City.

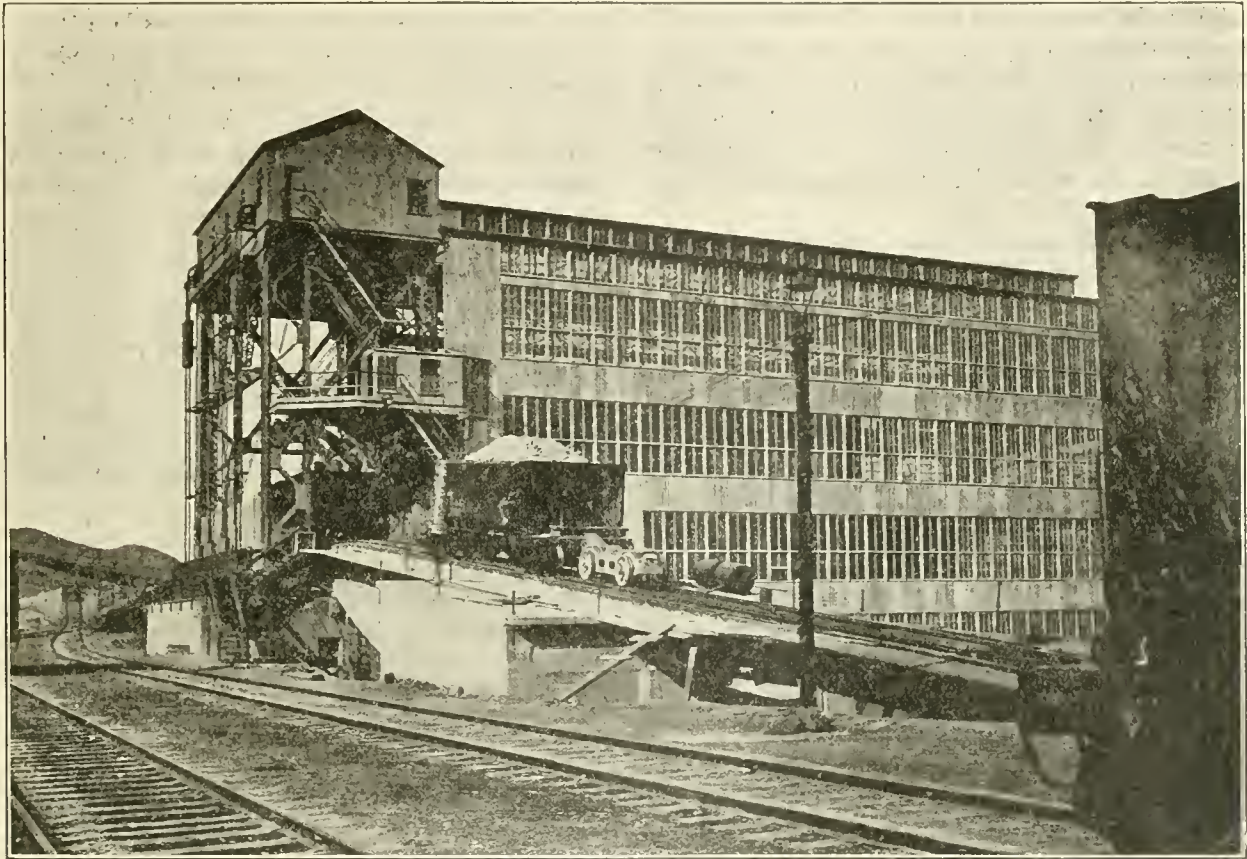
In smelter circles depression was as much evident as in mining, for the Illinois Zinc Co., at Peru, closed down its zinc, acid, and sheet-mills as well as its coal mines, throwing 1000 men out of work. This smelter has been for many years one of the best buyers of Wisconsin zinc in the district. The Matthiesen & Hegeler Zinc Co., another large buying concern of Wisconsin zinc ore, sold its plant to the Schwab interests. It was said this transaction was the aftermath of a clash between DuPont and Ford interests, in which the former sought to embarrass the automobile manufacturer and prevent the purchase of materials essential to Ford. At any rate, B. Lissinger & Co., of New York, come into control of the smelter at LaSalle, also a buyer of Wisconsin zinc ore since 1879. Zinc operators here regard the passing of the M. & H. Zinc Co.'s smelter into Schwab's hand as a good omen for the zinc industry, in that it will result in the stabilizing of zinc-mine products. Whether they are correct remains to be seen, but it is known that representatives of the LaSalle smelter have intimated that they will require Wisconsin zinc ore in quantity.

Lead-ore offerings for December were stationary at

\$47.50 per ton. Shipments were almost nil, less than 100 tons going to smelters during the month. This came from the Benton district. There were no shipments of iron pyrites, and only a small quantity of carbonate-zinc ore was marketed. The reserve of zinc ore of all grades in the field at the close of December amounted to more than 15,000 tons; of lead ore 3000 tons; iron pyrite, 30,000 tons; and carbonate-zinc ore, 500 tons. The gross recovery of milled ore for the month amounted to 11,503 short tons; net deliveries to smelters, 1533 tons, all of which came from the National Zinc Ore Separators at Cuba City, except four cars which were shipped from the

each succeeding year. The bulk of the gold production of British Columbia and Yukon Territory passes through this office. A telegraphic message from Alice Arm states that the Dolly Varden mine has been closed, and that the men had to walk the 18 miles from the mine to tide-water through deep snow. The cause for the closing is not known. It was the intention of the Taylor Mining Co. to have retained from 80 to 100 men on the payroll during the winter. It is supposed that some difficulty has arisen with the men.

STEWART.—H. A. Guess, managing director of mines for the American S. & R. Co., has instructed the Riblet



CAR-DUMPER AT THE ARTHUR MILL, AT GARFIELD, UTAH

Block-House mine, in the Platteville district and sold to the American Metal Co. Where ordinarily 5000 miners find employment, less than 1000 men were engaged at the end of December. Prospector work with drills dwindled to the lowest level known to the field in years. Building operations were brought to an abrupt halt all along the line.

BRITISH COLUMBIA

TRANSPORTATION FOR PREMIER MINE ORE.

VANCOUVER.—The Dominion government assay-office in this city reports that during 1920 the total number of deposits of precious metal received was 1348, valued at \$2,499,229, against 1391 deposits, valued at \$3,547,525, in 1919, and 1358 deposits, valued at \$4,099,595, in 1918. It will be noticed that the number of the deposits remains fairly even, but their value has shown a marked decrease

Tramway Co., of Spokane, to make an investigation of the transportation conditions at the Premier property and prepare estimates for an aerial tramway between the mine and tide-water. The working tunnel is about 1400 ft. above tide-water; 900 ft. of rise occurs in the last three miles to the mine. Since the heavy rains of last summer it has been found practically impossible to keep the road in repair, and, unless frosts harden the road considerably, it is feared that it will not be possible to ship the quantity of ore that was hoped during the winter. The ore is being culled more closely, and some 700 tons of high-grade that is expected to average above \$500 per ton is ready for shipment, while a large amount of medium and low-grade ore awaits the completion of the combined concentration and cyaniding plant. Construction work on the mill is progressing as rapidly as material arrives at the mine.

ONTARIO

POWER SHORTAGE THREATENS MINING COMPANIES AT PORCUPINE

PORCUPINE.—The available supply of electric power for the mines is about 1000 hp., and this limit is not likely to be exceeded before spring. It is being allotted to those consumers who have contracts with the power company. The Hollinger Consolidated receives about 2000 hp., which, combined with 1100 or more generated by its auxiliary steam plant, will enable the company to maintain operations at a satisfactory rate. The Dome Mines will get upward of 1000 hp. and will have to curtail underground operations to some extent. The McIntyre will reinforce a comparatively small supply of power from the power company by about 250 hp. from its auxiliary plant, enabling it to carry on operations at about two-thirds capacity. At the North Crown, which has been allotted 250 hp., the mill has been closed down and underground work on the 500-ft. level will be continued. The Porcupine mine managers will hold a conference with the power-company officials to settle disputes which have arisen as to priority of claims for power and as to the liability of the company for the extra cost entailed by the development of auxiliary steam-power.

The Dome Lake has sold its machinery to the North Davidson. The buildings are being preserved with a view to the possibility of resuming work at some future time.

KIRKLAND LAKE.—Progress is being made with the proposed merger of the Teek-Hughes and Orr gold mines. The plan under consideration includes the organization of a new company capitalized at \$5,000,000 in shares of the par value of \$1, of which 2,500,000 shares will be assigned to the Teek-Hughes stockholders and 1,500,000 shares to those of the Orr, leaving 1,000,000 in the treasury. The King Kirkland has ordered a mining plant and, following its installation, development will be started on a substantial ore-shoot outcropping on the surface.

COBALT.—Power shortage is considerably curtailing production, without any prospect of an improvement in conditions until spring. The Beaver and McKinley-Darragh mines have closed down, but the underground workings of both mines are being kept clear of water, so as to enable operations to be resumed when power is available. The Kerr Lake dividend of 12½¢. per share, payable January 15, will bring the total return to shareholders up to \$5.860,000. Production has declined somewhat during the past year, but the discovery of three new veins containing some high-grade ore gives promise of a satisfactory output during the coming season. At the Bailey a two-inch vein of high-grade ore has been discovered at the 240-ft. level which is reported to run 4000 oz. per ton. The annual report of the Coniagas stated that 994,235 oz. of silver had been produced from 97,624 tons of ore, as compared with 940,267 oz. the previous year. There had been a total distribution of \$10,140,000 to shareholders in dividends and bonuses.

Shipments of high-grade ore were only 5.6 tons, the company being now dependent on the concentration of ores averaging about 10 oz. per ton, the re-grinding of sand tailing, and the cyanidation of slime. A considerable tonnage of low grade milling rock has been developed.

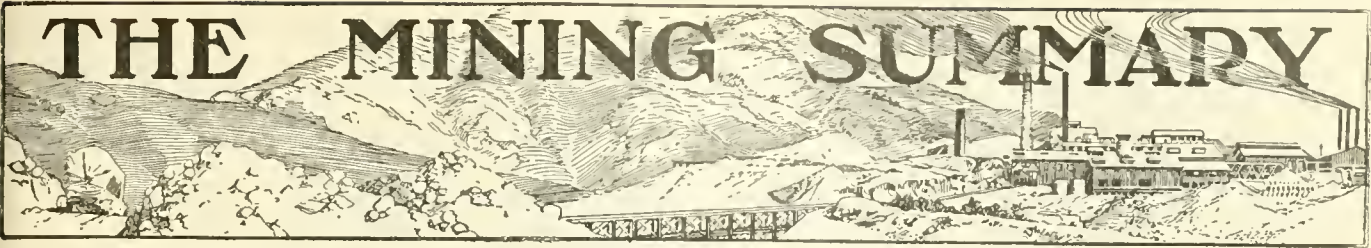
MEXICO

COPPER AND SILVER MINES SUSPEND OPERATIONS.

MOSTLY.—Unless there is an early improvement in mining conditions in Mexico some of the smelters that are now in operation may have to close soon on account of shortage of ore. From all of the larger mining districts, with the exception of Guanajuato, come reports of the closing-down of mines and the contemplated suspension of work upon other properties. From San Luis Potosi comes the announcement of the closing of the rich mines of the Santa Maria de la Paz Mining Co. which was the largest producer of ore in that State. Rafael Bustamente and associates have ceased to operate their mines in the Velardeña district of the State of Durango. Other mines in that district are also closed. In the Santa Eulalia, Santa Barbara, and Parral districts of the State of Chihuahua the closing of most of the big ore-producing properties has already taken place or is contemplated. Mining operations generally in the rich Pachuca district of the State of Hidalgo have been suspended with the result that the laboring element there is threatening trouble.

The shortage of fuel, together with the low price of silver and copper, is given as the cause of the closing down of numerous mines. It is stated that the Government is seeking to remedy existing conditions. It is expected that coal and coke will be available and equal to all demands within the next few weeks. The strike of coal miners in the State of Coahuila, where the principal fuel supply for the mines of all northern Mexico is obtained, has been settled but the mines were flooded during the prolonged shut-down and it will take some time to drain them and place them on a producing basis again.

AGUA PRIETA.—Details of the recently announced plan of the Mexican government to remove export duty on silver are set forth in the following statement: "When silver is quoted on the New York stock exchange at 60c. or lower, exportation fees into the United States will be revoked. With prices ranging between 60 and 70c., one-half of one per cent duty will be imposed; when between 70 and 80c. the fee will be one per cent; between 80 and 90c. one and one-half per cent. Ores and concentrates will be exported into the United States at an increased rate of one per cent, provided that the market is quoted at the low standard." Silver is now shown at Agua Prieta, for customs-house purposes, at a value of 60c. per pound, and copper at 10c. The prices used in December for customs-house purposes was 80c. for silver and 15c. for copper. During the past year customs-house quotations were as high as \$1.20 for silver and 20c. for copper. The new figures will apply until there are changes in the actual market value of the metals.



UNITED STATES SMELTING COMPANY

In view of the fact that United States Smelting will show a final balance after depreciation, depletion, taxes, and inventory adjustments for 1920 of but \$3.50 per share on the common stock, directors unquestionably were as liberal as could be expected in declaring a 50c. dividend for the final quarter. This makes a total of \$5 paid during the year, the difference coming out of surplus. It goes without saying that last year was the poorest experienced by United States Smelting since 1914, when a balance of but \$1.60 was returned for the junior shares. Last year the earnings were equivalent to over \$14 and in 1916 to over \$20 per share. In the first five months of this year alone net profits were only slightly less than the probable total for the full year. It is understood that all metals were marked down, in determining estimates of the showing for the year, to slightly below present market quotations, which means less than 63c. for silver, less than 4½c. for lead, and less than 13½c. for copper. The drop in silver has been the largest single factor in upsetting the splendid start which the company made in the spring. The price has been more than cut in two. This is of tremendous weight, since production has been climbing and will reach record-breaking figures this year. Purchase of a big lead and zinc property, the Cardonal, and of additional silver mines, both in Mexico, have resulted in some reduction in net quick assets which last year were augmented \$4,000,000 principally as a result of the sale of the interest in the Chrome, New Jersey, refinery. Net quick assets now total about \$12,500,000 or more than the \$12,000,000 note issue. Incidentally, nearly \$1,000,000 of these notes have been acquired by the company in the open market and are in the treasury.

ARIZONA

Miami.—Fire caused almost complete destruction last week of the blacksmith shop, the tool-sharpening room, and adjoining buildings of the Live Oak group of the Inspiration company. It is thought that the fire started from ignition by one of the furnaces of fuel-oil flowing from service-tanks.

Bisbee.—Work of sinking the Junction shaft of the Calumet & Arizona Co. from the 1800 to the 2300-ft. level is progressing satisfactorily; on January 1, 363 ft. had been sunk, and 157 ft. was left to sink. Two compartments are being sunk and the rest of the shaft will be raised. With concreting and the cutting of stations much work will be left when the two compartments have reached the 2300-ft. level. At the Campbell shaft of the Calumet & Arizona Co. there was left on January 1, 427 ft. to strip down to the 1400-ft. level. This will be accomplished in about six weeks, after which it is probable that more sinking will be done.

CALIFORNIA

Death Valley Junction.—The mine and calcining plant of the Pacific Coast Borax Co. have been closed completely, throwing 150 men out of employment. High freight-rates are said to be the cause, as borax from the mines of the company in Asia Minor can be laid down at Atlantic Coast points cheaper than from Death Valley.

Shasta County.—F. A. Zimmerman has sold a half inter-

est in his quartz mine near the old town of Shasta to J. L. Anderson. They announce that they will spend \$10,000 in equipment and betterments and erect a five-stamp mill on the claim in the spring.

The new reduction works of the Shasta Zinc & Copper Co. at the Bully Hill mine will be completed by April 15 according to present calculations. Construction was interrupted for 25 days during the stormy weather in December, but all the buildings are under roof, so that there will be no further delays. The company is employing 220 men. When the plant is in operation it will require about 180 men. The capacity at first will be 300 tons per day. Plans are made to double this later on. The buildings constructed, or under construction, are the reverberatory building, bag-house, crushing section, cooling chamber, bins, and warehouse, the last a building 90 by 200 ft. All buildings are of steel on cement foundations. At one stage of construction steel was bought in the East at \$200 per ton. The same steel is purchased now in the same market for \$130 per ton. Most of the steel used in the construction of the buildings was obtained by tearing down the Balaklala's smelter at Coram.

COLORADO

Leadville.—Production of \$6,535,577 in gold, silver, lead, copper, zinc, manganese, and sulphur is estimated for 1920, the figures being as follows: zinc, 19,754,482 lb., valued at \$1,525,046; silver, 142,285 oz., \$1,233,668; gold, 33,396 oz., \$690,283; lead, 9,328,234 lb., \$419,771; copper, 1,043,034 lb., \$1,525,046; manganese, 5125 tons, \$153,750; sulphur, 8000 tons, \$144,000. A decrease is shown as compared to the 1919 figures of \$2,183,089, or 35.6%.

IDAHO

Coeur d'Alene.—Dividends from the mines of the district for 1920 have been \$5,063,509, compared with \$2,663,500 in 1919. This is chiefly due to the dividends of the Callahan Zinc and the Hercules companies. The latter is not a corporation but a close syndicate which gives no information of disbursement, the figures being estimates. The table of dividends during 1920, and the total, compared with the total of 1919, is as follows:

Company	1920	1919
Bunker Hill	\$1,962,000	\$1,144,500
Caledonia	208,400	312,600
Federal	719,271	450,000
Hecla	650,000	600,000
Hercules	900,000	.....
Callahan Zinc	756,000	.....
Tamarack & Custer .....	.....	56,400
Lessees	120,000	100,000

Total\$5,306,271 \$2,663,500

Important reductions on freight-rates on Coeur d'Alene ores have been granted. The reduction in freight-rates on ores to the smelters was vital to the district and the Interstate Commerce Commission finally agreed to it on the urging of the three railroad companies concerned—the O.-W. R. & N., the Northern Pacific, and the Great Northern. The reduction goes into effect on the O.-W. R. & N. and the Great Northern on February 1. These lines handle the ores of the

Hercules and Tamarack & Custer mines, which go to the smelter at Northport. The reduction went into effect on January 1 on the Northern Pacific, which handles ores of the district going to the smelter at East Helena, Montana. The reduced rates are said to be \$3 per ton from the Coeur d'Alene to both Northport and Helena on ores of value not exceeding \$50 per ton, with 25c per ton added for each additional \$10 per ton of value up to \$4.75 per ton for \$100 ore, and \$5 per ton for ore over \$100 per ton in value.

The following notice has been posted at Kellogg, by the Hunker Hill & Sullivan company:

"Notice to all employees: The price of lead has fallen from 9c per pound September last to a present price of 47 and 4½c per pound. This is the lowest price in over five years and no longer makes possible the further payment of the present bonus of \$2.25 per shift. The bonus additions, 50c each, announced July 20, 1919, and February 16, 1920, are withdrawn." The wages paid under the above schedule will be \$4.75 for miners and \$4.50 for muckers.

The general manager, Stanley A. Easton, said that it is planned that local operations will continue at their present full scale and that there will be no curtailment or layoff of men or reduction in the amount of new construction and current building.

NEVADA

Elko County.—The Catlin Shale Products Co., said to be backed financially by the New Jersey Zinc Co., is developing a large deposit of oil-shale in the Elko field. The shaft is reported down 400 ft. in a shale stratum 90 ft. wide. The rock is said to yield approximately 50 gal. of high-grade oil per ton.

Eureka County.—Work by the Ruby Hill Development Co. in the Locan shaft of the Richmond-Eureka mine has been resumed. On the result of operations in the Locan shaft will probably depend the operation of most of the other mines in the Eureka district next spring and summer, as the finding of large and valuable bodies of ore 500 ft. below the present lowest depth of the Ruby Hill mines would encourage deep-level mining elsewhere in the district. During the last three weeks there were shipped from Eureka district, over the Eureka-Nevada railway, to the Utah smelters eight cars of ore from the Eureka-Holly mine; ten cars of ore from the Eureka-Croesus mine, and 72 cars of speiss from the Richmond-Eureka smelters.

BRAZIL

Rio De Janeiro.—The United States Steel Corporation has purchased the large manganese mines situated at Morra Da Mina, about 300 miles from Rio De Janeiro in the State of Minas Geraes. These mines contain large tonnages of good manganese ore and the purchase makes the Corporation independent concerning its supply of manganese ore, which is essential in the manufacture of iron and steel. The company has been receiving shipments from Morra Da Mina for several years. The price is reported as being approximately \$4,000,000.

MANITOBA

Flin Flon.—The Canadian government has made some important modifications of the mining regulations in view of the development of the Flin Flon copper deposit. The rule providing that ores must be treated and refined in Canada has been relaxed so as to permit blister copper to be exported for the final refining process, owing to the cost of sending it to the Trail smelter in British Columbia which is the only place in Canada where the electrolytic refining process is in operation. It is also provided that the product of the Flin Flon mines in which gross recoverable values average less than \$10 per ton shall be exempted from the payment of royalties for a period of ten years from January 1, 1921.

PERSONAL

The Editor invites members of the profession to send particulars of their work and appointments. The information is interesting to our readers.

George Fairbairn has left London for Mexico.

H. D. Moffat was at McGill, Nevada, last week.

Frank T. A. Smith, of Burnet, Texas, is at Los Angeles.

J. B. Davis has returned from Dutch Guiana to San Francisco.

N. C. de Rowne has moved from Berkeley to Socorro, New Mexico.

R. C. Gemmell, accompanied by C. B. Lakenan, is in San Francisco.

E. P. Davis has moved from Salt Lake City to Cheyenne, Wyoming.

Charles Billick has returned to Alturas, California, from La Paz, Bolivia.

Edwin T. Hodge has moved from Vancouver, B. C., to Eugene, Oregon.

Walter R. Vidler has returned to Denver from Long Beach, California.

Gordon S. Duncan has joined the firm of Wilkens & Devereux, in London.

R. A. Kent has moved from Leadville, Colorado, to Los Cerrillos, New Mexico.

J. M. Callow is at Superior, Arizona, and expects to return to Salt Lake City next week.

Robert G. Davies, who has been at Guadalupe, Zacatecas, Mexico, is now at Berkeley, California.

Alexander Anderson, of Edinburgh, Scotland, is in San Francisco. He was formerly at El Oro.

Arthur W. Burgren, of Matehuala, San Luis Potosi, Mexico, is at Knight's Ferry, California.

Imer Pett, general manager for the Bingham Mines Co. at Salt Lake City, is in Washington, D. C.

George C. Mackenzie has been appointed secretary of the Canadian Institute of Mining & Metallurgy.

Edmund A. Guggenheim, director of the Chile Copper Co., is now on his way to Chuquicamata to inspect the company's properties.

J. R. Elliott, of Pittsburgh, Pennsylvania, president of the Three Kings Mining Co. at Park City, Utah, is on a holiday in southern California.

F. M. Sylvester, formerly general manager for the Granby Consolidated, is now president of the Moore Group Mining Co., on Alice Arm, B. C.

Mark R. Lamb sailed on January 1 from New York on one of his regular visits to the mines of South America for the New York Steel Exchange, Inc., for which he is purchasing agent.

R. P. McLaughlin has resigned as Oil and Gas Supervisor of California in order to resume practice as petroleum engineer and geologist with an office at 485 California St., San Francisco.

George W. Gray, who for several years has been chief mining engineer for the Dome Mines company, has been placed in full charge of mining operations for the Canadian Associated Goldfields.

George E. Farish has resigned as managing director of the properties in Central America to which he has exclusively devoted his time for the past two years and has resumed his general consulting practice at 25 Broad St., New York.

THE METAL MARKET



METAL PRICES

San Francisco, January 11

Aluminum-dust, cents per pound	65
Antimony, cents per pound.....	9.50
Copper, electrolytic, cents per pound.....	14.00—14.50
Lead, pig, cents per pound.....	5—6
Platinum, pure, per ounce.....	\$73
Platinum, 10% iridium, per ounce.....	\$105
Quicksilver, per flask of 75 lb.....	\$50
Spelter, cents per pound.....	8.25
Zinc-dust, cents per pound	12.50—15.00

EASTERN METAL MARKET

(By wire from New York)

January 10.—Copper is more active and steady. Lead is livelier and stronger. Zinc is quiet and steady.

SILVER

Below are given official or ticker quotations for silver in the open market as distinguished from the fixed price obtainable for metal produced, smelted, and refined exclusively within the United States. Under the terms of the Pittman Act such silver will be purchased by the United States Mint at \$1 per ounce, subject to certain small charges which vary slightly but amount to approximately three-eighths of one cent. The equivalent of dollar silver (1000 fine) in British currency is 46.65 pence per ounce (925 fine), calculated at the normal rate of exchange.

Date	New York cents	London pence	Average week ending
Jan. 4.....	65.87	41.75	Nov. 29..... 73.72
" 5.....	67.62	42.50	Dec. 6..... 69.08
" 6.....	68.62	42.50	" 13..... 62.54
" 7.....	66.75	41.50	" 20..... 63.77
" 8.....	65.62	40.87	" 27..... 63.77
" 9 Sunday			Jan. 3..... 65.40
" 10.....	65.12	40.12	" 10..... 66.60

Monthly averages

	1918	1919	1920		1918	1919	1920
Jan.	88.72	101.12	132.77	July	99.62	106.36	92.04
Feb.	85.79	101.12	131.27	Aug.	100.31	111.35	96.23
Mch.	88.11	101.12	135.70	Sept.	101.12	113.92	93.66
Apr.	95.35	101.12	119.56	Oct.	101.12	119.10	83.48
May	99.50	107.23	102.69	Nov.	101.12	127.57	77.73
June	99.50	110.50	90.84	Dec.	101.12	131.92	64.78

COPPER

Prices of electrolytic in New York, in cents per pound.

Date	Average week ending
Jan. 4.....	12.75
" 5.....	12.75
" 6.....	12.75
" 7.....	13.00
" 8.....	13.00
" 9 Sunday	
" 10.....	13.00

Monthly averages

	1918	1919	1920		1918	1919	1920
Jan.	23.50	20.43	19.25	July	26.00	20.82	19.00
Feb.	23.50	17.34	19.05	Aug.	26.00	22.51	19.00
Mch.	23.50	15.05	18.49	Sept.	26.00	22.10	18.75
Apr.	23.50	15.23	19.23	Oct.	26.00	21.66	16.53
May	23.50	15.91	19.05	Nov.	26.00	20.45	14.63
June	23.50	17.53	19.00	Dec.	26.00	18.55	13.18

LEAD

Lead is quoted in cents per pound, New York delivery.

Date	Average week ending
Jan. 4.....	4.75
" 5.....	4.75
" 6.....	4.80
" 7.....	4.80
" 8.....	4.80
" 9 Sunday	
" 10.....	4.80

Monthly averages

	1918	1919	1920		1918	1919	1920
Jan.	6.85	5.60	8.65	July	8.03	5.53	8.63
Feb.	7.70	5.13	8.88	Aug.	8.05	5.78	9.03
Mch.	7.26	5.24	9.22	Sept.	8.05	6.02	8.08
Apr.	6.99	5.05	8.78	Oct.	8.05	6.40	7.28
May	6.99	5.04	8.55	Nov.	8.05	6.76	6.37
June	7.59	5.32	8.43	Dec.	6.90	7.12	4.76

TIN

Prices in New York, in cents per pound.

Monthly averages

	1918	1919	1920		1918	1919	1920
Jan.	85.13	71.50	62.74	July	93.00	70.11	49.29
Feb.	85.00	72.44	59.87	Aug.	91.33	62.20	47.60
Mch.	85.00	72.50	61.92	Sept.	80.40	55.79	44.43
Apr.	88.53	72.50	62.17	Oct.	78.82	54.82	40.47
May	100.01	72.50	54.99	Nov.	73.67	54.17	36.97
June	91.00	71.83	48.33	Dec.	71.52	54.94	34.12

ZINC

Zinc is quoted as spelter, standard Western brands, New York delivery in cents per pound.

Date	Average week ending
Jan. 4.....	6.00
" 5.....	6.00
" 6.....	6.00
" 7.....	6.00
" 8.....	6.00
" 9 Sunday	
" 10.....	6.00

Monthly averages

	1918	1919	1920		1918	1919	1920
Jan.	7.78	7.44	9.56	July	8.72	7.78	8.18
Feb.	7.97	6.71	9.15	Aug.	8.78	7.81	8.31
Mch.	7.67	6.53	8.93	Sept.	9.58	7.57	7.84
Apr.	7.04	6.49	8.78	Oct.	9.11	7.82	7.50
May	7.92	6.43	8.07	Nov.	8.75	8.12	6.78
June	7.92	6.91	7.92	Dec.	8.49	8.69	6.03

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, according to quantity. Prices, in dollars per flask of 75 pounds.

Date	Dec. 28.....	Jan. 4.....	Jan. 11.....
Dec. 14.....	55.00		50.00
" 21.....	50.00		50.00

Monthly averages

	1918	1919	1920		1918	1919	1920
Jan.	128.06	103.75	89.00	July	120.00	100.00	88.00
Feb.	118.00	90.00	81.00	Aug.	120.00	103.00	85.00
Mch.	112.00	72.80	87.00	Sept.	120.00	102.60	75.00
Apr.	115.00	73.12	100.00	Oct.	120.00	86.00	71.00
May	110.00	84.80	87.00	Nov.	120.00	78.00	56.00
June	112.00	94.40	85.00	Dec.	115.00	95.00	52.50

WORLD'S GOLD RESERVES

Aggregate gold holdings of banks of issue and governments of leading countries increased over \$3,000,000,000 since the year preceding the European war.

In other words, central gold reserves of leading countries increased from \$3,181,000,000 in 1913, to \$6,256,000,000 in 1920, or about 97%. These figures take no account of Russian gold, because no recent figures are available. In 1913, the Russian state bank had \$786,800,000, and in 1917, \$667,041,000. Records for subsequent years are missing.

Government gold counted in this connection is confined to gold held as reserve against currency, and bank figures represent actual vault holdings, exclusive of gold held abroad and of foreign credits.

This growth of gold reserve in central institutions represents in part the result of efforts by the governments to withdraw gold from general circulation and to concentrate it in banks of issue, where it supports fiduciary currency and also is available when international gold payments are to be made.

The following table shows central gold reserves of leading countries at most recent dates in 1920, compared with reserves at end of 1913, divided as to allied countries, Central Powers, and neutral countries, according to a recent compilation of Federal Reserve Board. Figures are millions of dollars.

Country	1920	1913	Change between 1913 and 1920
United States	2098	692	1406
England	738	170	568
France	683	679	4
Italy	204	288	84
Belgium	51	59	8
Rumania		29	29
Canada	95	115	20
Japan	451	65	386
India	116	73	43
Allied countries, total	4436	2170	2266
Germany	260	279	19
Austro-Hungary	45	251	206
Central Powers, total	305	530	225
Sweden	76	27	49
Norway	39	13	26
Denmark	61	20	41
Netherlands	256	61	195
Spain	474	92	382
Switzerland	104	33	71
Argentina	416	225	191
Java	89	10	79
Neutral countries, total	1515	481	1034
Total	6256	3181	3075

MONEY AND EXCHANGE

Foreign quotations on January 11 are as follows:

Sterling, dollars: Cable	3.77 1/2
" Demand	3.78 3/4
France, cents: Cable	6.24
" Demand	6.26
Lire, cents: Demand	3.61
Marks, cents	1.52

Eastern Metal Market

New York, January 15

The new year commences with very little activity in any of the markets. There is a better tone evident in tin and lead but copper and zinc are stagnant and weak. For the two latter metals prices have declined while for the former they have advanced slightly since a week ago. There is considerable optimism as to the future, however, and the opinion is expressed that the worst is over with 1920 and that 1921 will be a satisfactory year.

IRON AND STEEL

The country's pig-iron output fell off sharply last month, the total being 2,703,855 tons or 87,222 tons per day, compared with 2,934,908 tons in November, or 97,830 tons per day. Only 201 furnaces were in blast January 1. In December, 56 blew-out and 5 blew-in, making a net loss of 51. The active capacity at the opening of the new year was 76,540 tons per day, as against 90,040 tons per day for 252 furnaces on December 1.

With the beginning of the year independent producers announce a reduction in standard steel pipe to the Industrial Board basis of March 1919. Another reduction made in the past week was in bar-iron. The new Chicago price at 2.68c. figures back to 2.30c., Pittsburgh, or \$1 per ton below the market for steel bars.

The November exports of iron and steel, totaling 434,297 tons for pig-iron and rolled steel, make the 11 months exports of rolled products alone amount to 357,000 tons per month, or over 15% of the country's 1920 production. As most of the exporting independent steel companies allocated only 10% for foreign shipment, the statistics are an indirect indication of the large volume of the Steel Corporation's business.

COPPER

There has been no improvement in buying. Prices, however, have declined to some extent, but a real test of the market has not been experienced. A sale was made a few days ago of a small lot of electrolytic copper at 12.50c., producer's plant, but it was stipulated that the cash be paid before shipment. Later another sale was put through at 12.75c., delivered, for forward shipment. In the absence of activity the market is generally quoted at 12.75 to 13c., either delivered or New York, depending on the seller, for electrolytic copper for early or fairly prompt delivery. This level will be met by some or all the large producers. Lake copper is nominal at 13.75c., New York.

According to the U. S. Geological Survey the 1920 estimates of production from domestic ores was 1,235,000,000 lb. against 1,286,000,000 lb. in 1919; the output of refined copper, 1,573,000,000 lb. against 1,768,000,000 lb. in 1919; the apparent domestic consumption, 910,000,000 lb. last year as compared with 877,000,000 lb. in 1919 and the stocks of raw and refined copper on December 31, 1920, at 874,000,000,000 as contrasted with 904,000,000,000 lb. at the end of 1919.

TIN

The tone of this market is more optimistic although little business has been done thus far this year. Dealers are showing more interest than for some weeks but consumers have not yet displayed any desire to buy. There were no sales on the New York Metal Exchange the past week but about 200 tons of various lots, comprising metal for shipment from London and future shipment from the East, was sold. For the former £214 to £221 per ton was the price with an advance of two to three pounds per ton for the latter position, which was mostly January-February shipment. Spot Straits yesterday was quoted at 36c., New York, which

is about 2½c. higher than a week ago, the tendency having been upward since then. The tone of the whole market is decidedly improved and the feeling is quite general that 1921 will be a good year. London prices yesterday were £200 for spot standard and £210 10s. for future, with spot Straits at £215 10s., all higher than a week ago. Deliveries into consumption in December were 2580 tons with 2856 tons in stocks and landing on December 31. Total imports for 1920 were 50,563 tons against 35,404 tons in 1919.

LEAD

There has been a fair inquiry and considerable business transacted. Most of this has probably been taken by the leading interest at 4.75c., which continues to be its quotation, both New York and St. Louis. Independent sellers are not inclined any longer to meet this price but are asking 5c. or higher in both localities. While those higher levels are not reported to have been realized yet, the market is quoted steady at 4.75c., New York and St. Louis. A better tone in London is a stabilizer here also. In general the market may be characterized as exceedingly firm, but not really strong, and opinion seems confident that the bottom in lead has been reached.

ZINC

The market opens the year with a decline in values and almost stagnation in demand. The only favorable feature is that the London market has advanced rendering less the possibility of further imports in competition with domestic metal in Eastern markets. For this metal about 5.85c., seaboard, is the quotation, duty free, but this is too high to compete with domestic prime Western at central consuming points. Domestic market quotations are easy at 5.50 to 5.60c., St. Louis, and at 6 to 6.10c., New York, but there is a dearth of inquiry. Another favorable phase of the market is the large percentage of retorts out of use.

ANTIMONY

The market is devoid of feature and lifeless at 5.20c. per lb., duty paid, New York, for wholesale lots for early delivery.

ALUMINUM

Virgin metal, 98 to 99% pure, is quoted by the leading interest at 28.30c. f.o.b. producer's plant, in wholesale lots for early delivery, while the same grade by other sellers is quoted at 22 to 23c., New York.

ORES

Tungsten: Sellers are stiffer in their quotations this week than a week ago and prices are higher, nominally. The belief in, or at least hope for, a tariff may influence this sentiment. Spot ore is held at \$3.25 to \$3.50 per unit. There is no change in the ferro-tungsten market.

Molybdenum: No business or developments are noted and no quotations offered in the absence of demand.

Manganese: Quotations are nominal, there being no demand, at 35 to 40c. per unit, seaboard. Imports continue very heavy, having been 74,477 gross tons in November, bringing the total to 542,189 tons to December 1, 1920, against 296,968 tons to December 1, 1919.

Manganese-Iron Alloys: Ferro-manganese is quoted by British producers at \$110, seaboard, and could probably be bought for less were business offered. Re-sale has sold in one case at \$90. Imports were heavy in November at 7091 tons, so that the total to December 1, 1920, was 53,830 tons or nearly twice the imports to December 1, 1919, of 29,595 tons. Exports were 760 tons that month, which is fairly heavy. Spiegeleisen is inactive at around \$45 or less, furnace.

Book Reviews

The Technical Examination of Crude Petroleum, Petroleum Products, and Natural Gas. By William Allan Hamor and Fred Warde Padgett. 572 pp., ill., index. McGraw-Hill Book Co., Inc., New York. For sale by 'Mining and Scientific Press'. Price, \$6.

This is a manual of instructions for the chemical and physical analysis of petroleum, petroleum products, natural gas, and oil-shale. The book consists of two parts of almost equal length, the first, the book proper, containing theoretical discussion and directions for making the required tests, while a so-called appendix contains mathematical tables, standard specifications, etc. The book will be useful to the petroleum engineer and chemist.

Chemical Analysis of Special Steels, Steel-Making Alloys, Their Ores, and Graphites. By Charles Morris Johnson. Third edition. 541 pp., ill., index. John Wiley & Sons, Inc., New York. For sale by 'Mining and Scientific Press'. Price, \$6.

The author of this book is chief chemist of the Park Works of the Crucible Steel Co. of America. The sub-title shows the book to be particularly devoted to the rapid methods of analysis required in steel-works and other commercial metallurgical practice. The principal change in the third edition is the addition of a number of newly-developed methods of analysis for specific determinations. The book will be useful to the metallurgical chemist.

The Engineering Draughtsman. By E. Rowarth. 237 pp., ill., index. E. P. Dutton & Co., New York. For sale by 'Mining and Scientific Press'. Price, \$5.

As the spelling of the title, as well as the use of the word 'engineering', in place of 'mechanical', indicates, this is an English book, but, nevertheless, well-adapted to the needs of the American reader, particularly the student. It is intended primarily as a textbook for students already familiar with the elementary principles of mechanical drawing. It consists principally of a set of about one hundred exercises, each one comprising one or more line-drawings of a machine-part, the work assigned to the student being to reproduce the drawings with different dimensions, to draw a different view of the part, or in some other way to use his head and show that he really understands what he is doing. This feature makes the treatise an excellent textbook.

Compressed Air Plant. By Robert Peele. 506 pp., ill., index. John Wiley & Sons, Inc. For sale by 'Mining and Scientific Press'. Price, \$4.50.

This is the Fourth Edition of Mr. Robert Peele's admirable and comprehensive treatise on the production and use of compressed air. The new material consists of a chapter on the 'Measurement of Air Consumption', in which data are given respecting the flow of air through orifices and short tubes, and sundry appliances for measuring air both at low and at high pressure are described and explained; and addenda to the chapter on pumping by the direct action of compressed air. This deals with some recent work in air-lift pumping in unwatering deep mines and is of special interest to mining engineers. The author has enjoyed the co-operation of the manufacturers of compressed-air machinery, and in the first part of the book, which deals with the construction and operation of compressors, the theoretical and practical side of the design and use of the machines is thoroughly treated. Most of the second part, the sub-title of which is 'Transmission and Use of Compressed Air', is devoted to problems characteristic of mine-work.

An idea of the scope of this section may be had from the chapter headings: Conveyance of Compressed Air in Pipes; Compressed-Air Engines; Freezing of Moisture Deposited from Compressed Air; Re-heating Compressed Air; Compressed-Air Rock-Drills; Hammer Drills; Coal-Cutting Machines; Channeling Machines; Operation of Mine-Pumps by Compressed Air; Pumping by Direct Action of Compressed Air; Compressed-Air Haulage in Mines; and Measurement of Air Consumption. The author will be recognized at once as the editor-in-chief of the only complete handbook for the mining engineer—'Peele'. This is sufficient to assure the high standard of the treatise on compressed air.

Hand-Book of Mexican Properties and Securities, 1920-'21. Compiled by J. S. Curtiss & Co., El Paso, Texas. 390 pp., index. For sale by 'Mining and Scientific Press'. Price, \$5.

This book is the result of ten years labor in the collection of data, primarily on the general subject of securities, relating to the Republic of Mexico. It lists alphabetically the names of all the Mexican States, banks, Government bond issues, national railroads, cotton plantations, oil companies and refineries, mines and mining companies, ranches and ranch-owners. In addition, it carries other valuable matter such as a translation of Mexican mining terms, list of Government mining agents in each State, copy of the mining laws and their regulation, and a list of public utilities and industrial stocks. In view of the present bright prospects for a restoration of law, order, and security to investors in Mexico, this book has an interest which will be accentuated as time goes on. It will be valuable to anyone interested either as an investor or merchant, who has in contemplation opening up business relations in the territory south of the Rio Grande.

Cost of Mining. By J. R. Finlay. 532 pp., ill., index. McGraw-Hill Book Co., New York. For sale by 'Mining and Scientific Press'. Price, \$6.

Ten years ago Mr. Finlay's 'Cost of Mining' was received with enthusiasm by the members of the profession as being the most comprehensive as well as the most reliable (the difficulties in obtaining entirely reliable data are only too well known to most of us) compilation of information on the elements of cost in mining coal, iron, copper, and the other more important metals. His book, however, was more than a compilation, for Mr. Finlay had clothed the bare figures with his comment and analysis; his twenty years of varied experience had given him an unusual insight into the economic problems involved in mining different metals in different regions. In the present volume the reader familiar with the earlier edition will find it enriched by ten years of riper experience on the part of the author. Mr. Finlay, unnecessarily, we think, asks indulgence for interjecting material of a broader scope and some "generalizations on geologic history and processes" among the statistical matter. Indeed, the question was entertained of changing the name of the book; this was decided in the negative in spite of the fact that the name hardly does justice to the new edition. The winning of metals as an economic problem intricately connected with other industries is considered from sundry angles; the valuing of mines, the financing of them, and the marketing of their products are discussed from a broad standpoint. As the author says, mining is an industry with which 20,000,000 English-speaking people are directly concerned and in which a great many more are vitally interested. It commands the interest of perhaps 20% of the people in the world. 'Cost of Mining' is an unusual book that may well be read with benefit by every thoughtful student of world conditions today; it is one that no mining engineer can afford to be without.

A. B. P.

INDUSTRIAL PROGRESS

INFORMATION FURNISHED BY MANUFACTURERS

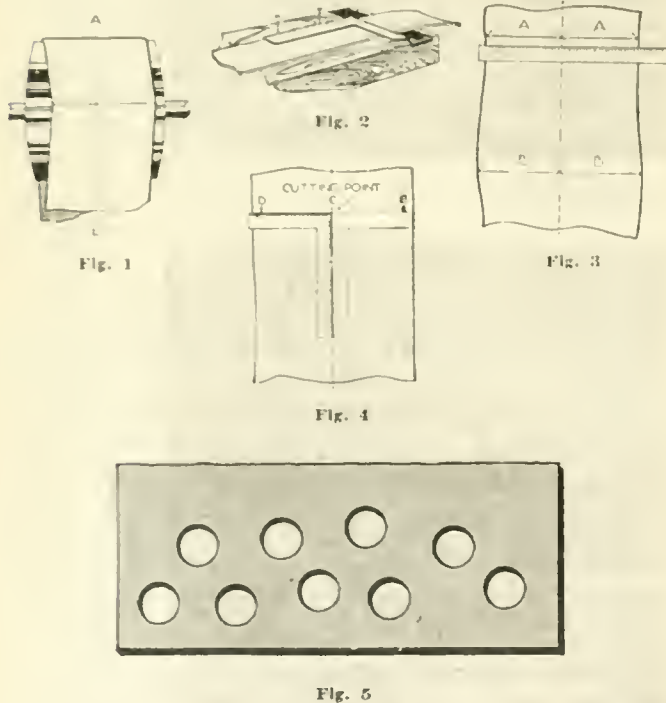
HOW TO JOIN BELTS

By F. D. Rich*

Human nature plays an important part in getting service and longer life out of a belt. It is human nature to do things in what seems the easiest way, not always realizing it is often the most expensive and usually the most laborious, because it necessitates doing the work over and over again. This applies particularly in the case of cutting belting and joining it.

Cutting the ends of a belt to put it into service seems such a simple thing that often the belt-man does not give it the consideration necessary to ensure the best results, and much of the difficulty with otherwise good belts is due to their not being cut and joined accurately.

When a belt runs wobbly or races back and forth across



the pulleys, it is not giving its best service nor can it have its longest life. If you have a belt that is repeatedly jumping off the pulleys, you are paying about twice as much as you should for it, because its life is being shortened and you are paying for power that is lost and production that you don't get. You are also repeatedly paying for unnecessary time and labor in fixing things up.

Provided that its ends are cut square and it is joined with care, a belt can be made to run as straight as an arrow if the pulleys are lined-up true.

Don't guess at cutting your belt-ends. Use a square—always—and use it with care. If you do not use a square, one or both of the ends will be cut unevenly or irregularly,

which prevents smooth running. Even the use of a straight-edge does not assure the perfect results obtained by using a square, for the slip of a fraction of an inch will bring the belt ends together at an angle, as shown in Fig. 1.

This results in the belt 'shimmying' on the pulleys, which is bad for the belt and impairs its service, imposing shifting and irregular strains, which no belt can stand indefinitely.

There is only one way to assure correct results. That is to use a belt-square and to keep it in place until you have cut all the way through the belt. Don't just scratch the surface and then hack through. Cutting to the square assures an even cut all the way through the belt and all the way across. It means that the belt ends can be brought together in a tight, even-running, flush joint.

Be sure your knife is sharp. Wet the point of your knife occasionally, as it cuts more easily when the blade is wet.

When a number of belts have to be cut, a good stunt is to drive two nails in a large block of wood, and against these set the edge of the belt and the edge of the square, as shown in Fig. 2. This prevents either the belt or the square slipping. Some men tack a slip of leather or a piece of old belt on the end of the block to protect the point of the knife as it comes through the belt.

Wide belts are more difficult to square correctly, and the difficulty is often increased by slight variations in width, which throws the square out. To avoid this and assure perfect results, the method described below has proved the best.

At any point near where you are going to cut the belt, measure across and find the centre, as at 'A-A', Fig. 3. At any distance back of this, 2 or 3 ft., find the centre again, as at 'B-B'. Between these two centre points draw a clean sharp line. This marks the centre axis of the belt.

Now, as in Fig. 4, using the square against the centre line, trim off the end of the belt, holding the square firmly in position while you cut all the way through. Two small nails driven in on the centre line will keep the square from slipping.

For cutting the other end of the belt, find the centre line, the same as just described. Then at any point on this line other than where your belt clamps will come, take a point 'C' as in Fig. 4. Then using the square as illustrated, draw a line 'D-C-E' at right angles to the axis, and all the way across from edge to edge. This line 'D-C-E' will constitute a 'base line' to measure from after the belt is in the clamps. Do not cut on this line.

You can determine exactly where you want to cut after the clamps have been put on and the belt brought into position. Then measure forward from the line 'D-E' an equal distance on each side of the belt to the cutting-point. You can use calipers and measure over the belt-clamp or run your ruler through the edges of the clamp. As a matter of convenience, always cut one end of the belt square and get it ready for making the joint before putting the belt into the clamp.

Personally, the writer, who has had considerable experience in working with belting manufacturers in solving the difficult problems of efficient belt joining, is very much opposed to methods which punch holes in the belt or which in

*Mr. Rich is sales manager for the Crescent Belt Fastener Company.

any way cut or weaken the lengthwise power-carrying fibres of the belt.

It is no uncommon thing to see, in journeys through manufacturing plants, laced belts in which from 40% to frequently more than 70% of the cross-section of the belt is removed in punched holes. How in the name of common sense can such a belt-joint (see Fig. 5) be expected to give the full service of the belt? Many manufacturers are today running belts much heavier and more expensive than their requirements, in an attempt to get strength at the joint.

Below is a table showing the qualifications of the perfect belt-joint, by which any engineer can check up the comparative efficiency of his own methods.

(1) Will maintain maximum strength of belt.

(10) Is safe against accidents or breakdowns.

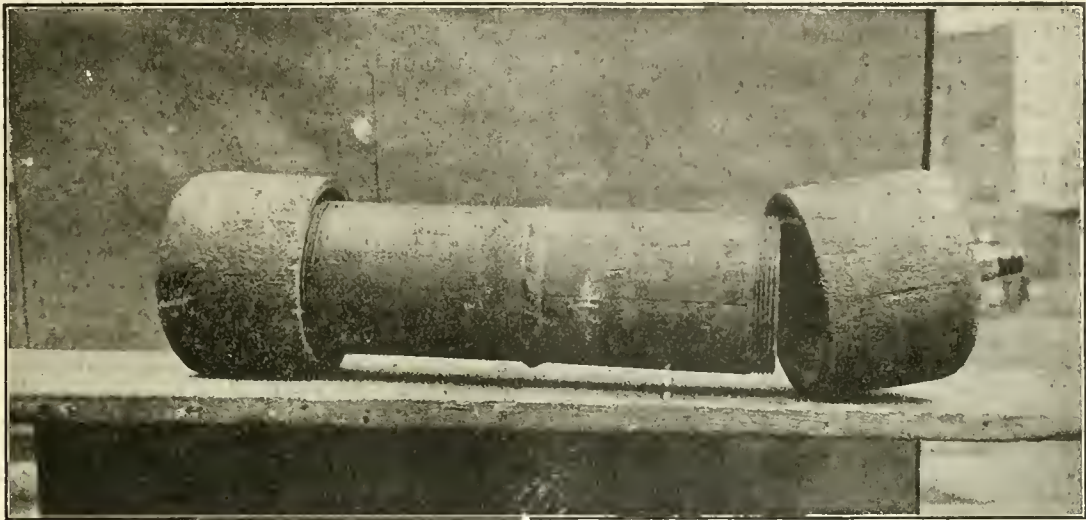
(11) Must be easily and quickly made without special equipment.

(12) Will last for the life of the belt.

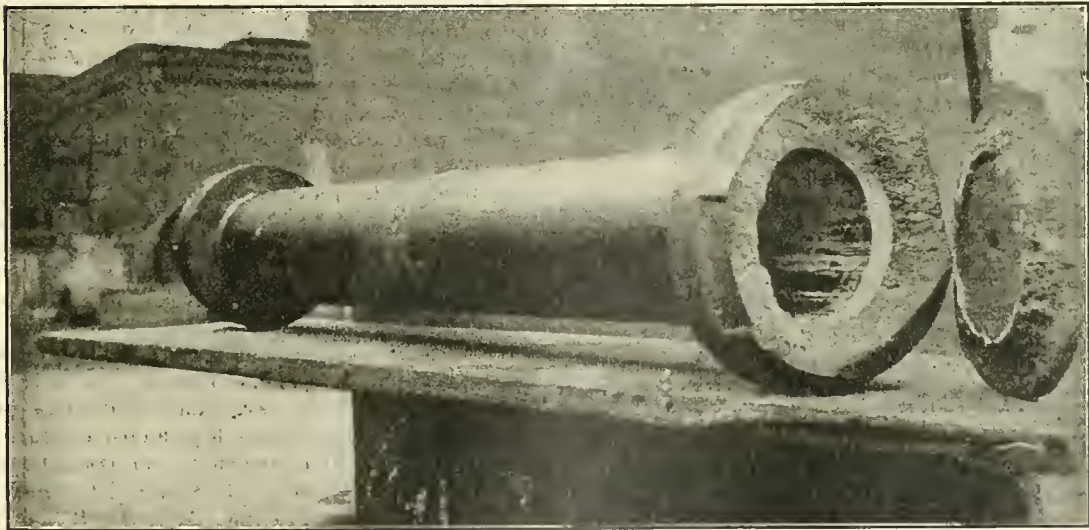
But regardless of what method of joining is used, the belt should always be cut square, so that it may exert a straight-line pull and perform its function of power-transmission efficiently.

OIL-MEN WITNESS REMARKABLE WELDING TESTS

The recent Gas show at Buffalo brought together men in all branches of the industry from every part of the country. In the course of informal discussion on oxy-acetylene welding of oil pipe-lines a big Kansan questioned the strength of



Welded Pipe. Break In Threads.



Welded Pipe. Break In Standard Cap.

- (2) Will avoid destruction or weakening of the lengthwise power-carrying belt fibres.
- (3) Should prevent breaking the belt back of the joint.
- (4) Must not hammer on the pulleys.
- (5) Must not be subject to wear or to crystallization.
- (6) Will ensure continuous uninterrupted operation without supervision.
- (7) Hugs the pulleys tightly and ensures full transmission of power.
- (8) Runs silently, same as endless.
- (9) Can be easily taken apart for removing or shortening the belt.

the welded line to hold up under the service pressures in his field. Of course there are abundant instances where welded lines are in service in oil districts, carrying pressures of 800 to 900 lb.; but the skeptic was not entirely satisfied. What he wanted was a breaking-pressure test to determine just where the welded pipe would give way under breaking-strains. In his opinion the break would occur in the weld. The discussion took place, as it happened, in a stronghold of oxy-acetylene welding. One of the factories and machine shops of the Linde Air Products Co. is situated in Buffalo, and it is in its big Buffalo laboratory that the development department engineers of the company conducted its experi-

ments and tests in working out application problems for users of oxygen and acetylene in welding and cutting. This circumstance led to a series of tests to finally settle the matter in the minds of those concerned.

A test was made with 4-in. pipe. Two short lengths were welded together, the ends threaded and two extra-heavy standard caps screwed on. In this test one of the cap-heads blew out at 4400 lb., which gave a total end pressure on the cap of approximately 33 tons, proving that the broken cap was not in any respect defective. The weld was not impaired at all. After this test it was suggested that an entirely new weld with other pipe lengths of the same diameter be tried. Accordingly, two more lengths of 4-in. pipe were welded, threaded, and sealed, this time with extra heavy steel caps made to withstand a working pressure of 3000 lb. of air. The pressure was applied and the pipe gave way in the threads at 4200 lb. In all of the tests the welds held securely.

The gentleman from Kansas decided that if there is anything stronger than a good oxy-acetylene weld it is not needed in the oil-fields of the South-West. He examined a large number of welded-pipe specimens that had been subjected to hydrostatic breaking-tests, finding that in no instance had the pipe given way at a weld. He also inspected the shop welding and testing-equipment with unusual interest, from the familiar Oxweld blow-pipes to the big pumps that supply pressure for tests up to 10,000 lb. per square inch.

STOCK-SUBSCRIPTION PLAN FOR DU PONT EMPLOYEES

E. I. du Pont de Nemours & Co. has announced a new plan for stock subscription by employees. The board of directors of the company has modified the former plan for stock subscription, which has been in effect since 1909, and has made important changes for the purpose of providing an opportunity for employees to invest their surplus earnings in such a way as to share in the profits of the company while enjoying the security afforded by the debenture stock. Employees who become stockholders under this plan will receive not only a fixed cumulative dividend on their stock, when declared, but also a participating payment at a rate increasing with the net earnings of the company and also a service payment based upon the length of service credited to them.

The plan for the participating payments based on the net earnings of the company provides that if the net earnings were at a rate equal to or greater than 8% but less than 9% per annum on the combined total invested capital, the participating payments will be at a rate of \$1 per share per annum.

The payments increase as the earnings increase until, if the net earnings were at a rate equal to or greater than 12%, the participating payments will be at the rate of \$5 per share per annum. The rate of service payments will be based on the years of continuous service with the company and will be made on the following basis: for length of service of one year and less than two years, \$1 per share per annum; for a service of two years and less than four years, \$2 per share per annum; for a length of service of four years and less than seven years, \$3 per share per annum; and for a length of service of seven years or over, \$4 per share per annum.

Under this plan, therefore, if a participant has been in the service of the company for seven years or more, and if the company's net earnings for the preceding year were at a rate of 12% or more on its combined total invested capital, subject to the declaration and payment of the regular cumulative 6% dividend, such employee will receive in all 15% or \$15 for the following year on each share of this debenture stock.

Any eligible employee may subscribe to an amount of this stock equivalent to not more than four times his monthly rate of salary or wages, but in no case to more than 20 shares. The plan provides that the stock must be paid for within one year. Those who desire to have their stock redeemed can do so under certain conditions. The stock will be redeemed by the company at \$100 per share.

COMMERCIAL PARAGRAPHS

The Mine & Smelter Supply Co. announces the appointment of J. L. Harman as manager of its branch house at El Paso, Texas.

Catalogue 'F', issued by the Ross Heater & Manufacturing Co., illustrates and describes the various types of heaters, condensers, expansion-joints, coolers, and 'Airjector-pumps' manufactured at the company's plant in Buffalo, New York.

The Victory Engineering & Sales Co., Monadnock Bldg., San Francisco, has issued an attractive catalogue in which are listed a complete line of pipe-fittings, pump equipment, and pumps. The Victory oil-motor is a feature of the company's products.

Bulletin No. 14-C, recently issued by the National Tube Co., of Pittsburgh, discusses tubular steel poles, and outlines various uses in industrial plants, railroads, municipal construction, and elsewhere. Some valuable data are given regarding the properties and specifications of pipe.

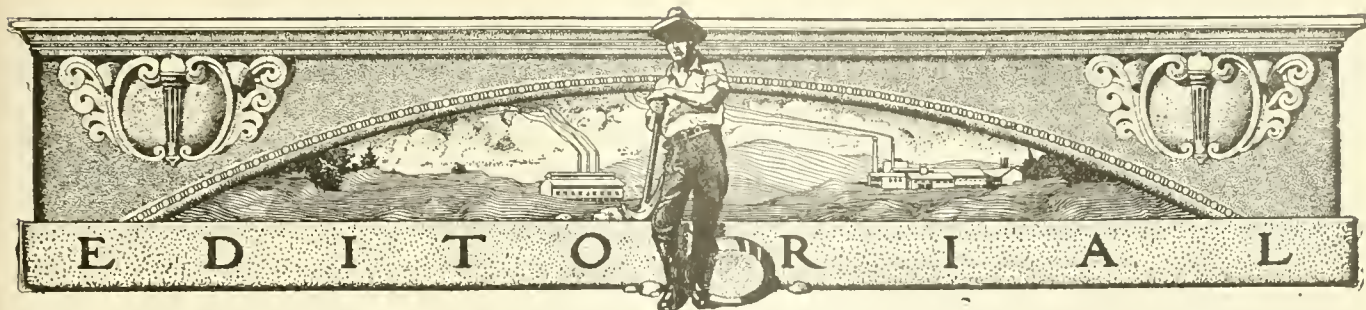
The business heretofore carried on at Waldo, New Mexico, by Grubnau, Bryant & Grubnau, as manufacturers of oxide of zinc, has been acquired with all assets and liabilities by the Grubnau Chemical Co., incorporated under the laws of the State of New Mexico, and will be continued by this company in the same way as heretofore.

James R. Moughn, sales engineer for the Mine & Smelter Supply Co., has been transferred from New York to Chicago. His address is 4555 Malden St. Mr. Moughn will look after the sales for the company in the Central States territory, and all inquiries originating in this territory for Marcy ball-mills, Marcy roller-mills, Wildley tables, and the company's other specialties will be taken care of by Mr. Moughn.

The Chicago Pneumatic Tool Co. announces the resignation of H. L. Dean, formerly manager of the Division of Compressor and Engine Sales. The company also announces the appointment of J. F. Iluvanc as Eastern manager of Compressor and Engine Sales, with headquarters at 6 East 44th street, New York, and G. C. VandenBoom as Western manager of Compressor and Engine Sales, with headquarters at 300 North Michigan Blvd., Chicago.

The Oxweld Acetylene Co. announces the appointment of the Standard Supply & Equipment Co., of New York and Philadelphia, as Eastern sales agent for 'Eveready' welding and cutting-apparatus and supplies. The Standard Supply & Equipment Co. deals in shelf and heavy hardware, machinery, mill and mine supplies, automobile accessories, etc., and has, besides its New York and Philadelphia establishments, branch houses at New Haven, Hartford, Springfield, Worcester, Pittsburgh, Trenton, and Altoona.

C. E. Grunsky Company, consulting engineers and economists, call the attention of their clients to the fact that they are prepared to assist them in their economic business problems requiring technical analysis. These problems include valuation and business analysis as a basis for determining the proper depletion and depreciation factors for use in preparing income-tax returns and in making adjustments with the Internal Revenue Bureau. The establishment of proper methods of obtaining the present worth of all business having wasting assets, and the preparation of appraisals of plants and equipment for incorporation and other purposes are undertaken. The company's office is at 57 Post street, San Francisco.



T. A. RICKARD. • • • Editor

EVIDENTLY there will be more Cabinet disappointments than appointments and quite as evidently the final choice will indicate whether Mr. Harding's administration is to be reactionary or progressive. Upon his choice will depend not only this cabinet but the one to be selected four years hence. It has been well said that the title of Secretary of the Interior would seem highly appropriate to our late Food Administrator; so would Secretary of the Department of Public Works; but we have not departed from our notion that it would be a pity to spoil Mr. Hoover's career by putting him into a cabinet in which he is sure to be uncomfortable, and therefore probably ineffective.

AS an example of the waste of public money, we mention a 100-page pamphlet received under the frank of Senator W. L. Jones giving the testimony of our friend Mr. William Denman before the committee of the House on Shipping Board operations. This gives Mr. Denman's personal views, including "an appreciation of General Goethals", with whom he had a regrettable public disagreement when he himself was chairman of the Shipping Board. We do not say that Mr. Denman's views on these or other matters are not interesting, but we do say they are not of such interest or importance as to warrant the spending of public money in paper, printing, and postage.

THE silver production of the United States last year is estimated at 56,564,504 ounces, out of the world's total output of 165,000,000 ounces. Thus our production of silver in 1920 was almost exactly equal to that of 1919, the difference of 17,941 ounces being within the limits of statistical error. Likewise the world's production of silver decreased only slightly, the difference being estimated at ten million ounces. This shows how much the steadiness of the supply contrasted with the vagaries of demand, for the price of silver ranged between \$1.38½ and 59½ cents during the past year. The world's consumption of silver in 1920 for coinage alone is estimated at 225 million ounces, which compares with 200 millions in 1919 and 238 millions in 1918. To these totals may be added about 125 million ounces annually for industrial purposes. Evidently the production is considerably less than the consumption, but the re-melting of large quantities of silver in various forms and from diverse sources renders

it impossible to make a direct and trustworthy comparison. On the whole, however, the evidence of trade statistics favors an optimistic view of the probable future course of market quotations.

CREDIT is due, and will have been given gladly, to President-elect Harding for his good sense in requesting an abandonment of the plans for a costly celebration of his inauguration to the Chief Office in March. He sent a letter-telegram on the subject to the chairman of the Washington Inaugural Committee and it was couched in terms of simplicity and sincerity that must have made an effective appeal to all thoughtful citizens. The decision to make the ceremony "a wholesome example of economy and thrift" is well advised, but we fear that it may deceive the country into the belief that our national legislature is committed to the policy of stopping the waste of public money.

NOMINATIONS for officers of the Institute have been made and the ballots issued to members. As only one ticket is in the field, it will be elected, of course. We note with pleasure that the next president will be Mr. Edwin Ludlow, now first vice-president. Mr. Ludlow has been identified chiefly with coal mining, in this country and in Mexico, but he is a man of wide engineering experience and possesses an ample understanding of the metal-mining industry. He has been a keen supporter of the Institute and a regular attendant at its meetings for a long period, so that he is personally known, and liked, by a larger proportion of members than most of his predecessors. He has executive ability, keen intelligence, and an engaging personality; therefore he ought to prove an excellent president. We wish him every success in his year of office.

WE take pleasure in publishing an article on the famous deposits of pyrite in the Huelva district of Spain, commonly identified with the mining operations of the Rio Tinto company. This article is contributed by Mr. Courtenay De Kalb, formerly Associate Editor of the 'Mining and Scientific Press'. Mr. De Kalb was engaged two years ago by the U. S. Department of Commerce to make an investigation and report on the mining and metallurgical industries of Spain. This account of the Huelva deposits represents a part of the large mass of valuable data collected by him while in Europe. To

has actually we append a timely and interesting summary of the history of the ancient mines of the Huclva district by Mr. D. W. Branton, who was engaged several years ago by the Rio Tinto company to advise upon the best method of mining applicable to local conditions. We shall publish an interview with Mr. Branton at an early date.

HERE are 20 stockholders of record of the Broken Hills Silver Corporation selected on January 7, almost at random from a list of 1000 or more." This is quoted verbatim from a two-column advertisement that appeared recently in a San Francisco newspaper. There follows a pretentious list of bankers, office-holders, and others, headed by Mr. T. T. Ansberry, "Attorney for Governor J. M. Cox of Ohio" and Mr. Ed. Malley, State Treasurer for Nevada. That the ad-writer overlooked the fact that Mr. Cox became ex Governor on January 1, indicates lack of discrimination, but that oversight is more than amended by the meticulous regard for the exact truth exhibited by qualifying "at random" with "almost". If 'almost' had been omitted the immutable laws of probability would have proved that no one of the fortunate thousand held a position less distinguished than that of director of a bank or warden of a State prison. But 'almost' leaves a substantial loop-hole; there may even be some stockbrokers and bootleggers among the 980 who are not classified. Evidently "almost at random" leaves much to the imagination in describing a method of selection: it is about as definite as the reply of the negro miner in Georgia who when asked how much ore remained in the bin replied, "Well there's right smart and yet not so very much either."

THE other day we were talking to the superintendent of a large and well-known concentrator in which flotation plays a part in the scheme of treatment; his views on the question of publicity with regard to the operations of his company are particularly interesting because of the contrast with the attitude taken by a great many users of flotation who are not licensees of Minerals Separation. We, of course, respect this attitude of reasonable reticence because we may not be aware of all the facts in a particular case. Our friend the superintendent said in substance, "I am confident that there is a man working in our mill today who, unknown to us, is keeping Minerals Separation apprized of everything done in our flotation department. Any good practical millman can get an accurate idea of what is being done without actually seeing the complete metallurgical reports. Moreover, if a suit is started, Minerals Separation simply goes into court and gets an order compelling us to produce our records. A moving-van comes around to our office and they take every scrap of paper in the place to court, where they introduce whatever they want as evidence against us. For that reason I personally see no object in suppressing the publication of articles giving every detail of operation. There is even an advantage in that some other operator who prefers not to saddle himself with one of Minerals Separation's 'generous' con-

tracts may find something helpful. We condemn Minerals Separation for withholding data regarding new developments and it seems to me inconsistent that we should do the same thing ourselves". Some of those who favor a policy of secrecy feel that if Minerals Separation learns of anything new or novel it will immediately take out a new patent and thereby add another tentacle to the sixty or seventy it already possesses. In this connection attention may well be called to a fact that is generally overlooked by those who have inventions, namely, that the publication, especially in a reputable technical periodical, of the details of a new device or process before it is patented is one of the most effective ways of protecting the idea. Such publication definitely fixes a date prior to which the invention was developed, and if the journal is one of general circulation among the members of a particular profession it furnishes strong presumptive evidence that a subsequent inventor derived his inspiration from reading the published description. A concrete example is the litigation over the process of vacuum-leaf filtration, wherein the publication, on our suggestion, by Mr. George Moore of an article describing his theory of filtration, through a porous leaf, of the liquid portion of a metallurgical slime, leaving the solid in the form of a cake on the surface, played an important part in establishing the priority of his invention, as against Mr. Charles Butters. As we said before, we respect the wishes of those who do not desire to give publicity to their operations, and under some circumstances we can recognize a valid reason for their attitude, but, it is rarely justifiable, or even advantageous to them, and is always a drawback to the progress of the metallurgic art.

A Noble Benefaction

In our last issue we devoted one of our advertising pages—number 32—to an appeal from the European Relief Council in behalf of the starving children of Europe. Mr. Franklin K. Lane, formerly Secretary of the Interior, is treasurer of this fund, which is being administered by Mr. Herbert C. Hoover. The devastation of war has left the populations of the belligerent countries of Central and Eastern Europe in a condition of pitiable destitution. For some of this they are themselves responsible, but the 3,500,000 of innocent and helpless children, exposed to famine and misery, make an appeal that must overcome any of the ill feeling surviving from the days of war. The appeal is not for all the children but only for the 3,500,000 that are reported, on competent American authority, to be in immediate danger of death by starvation. Ten dollars will provide for one child during this winter. The sum of thirty-three million dollars is asked. Mr. Hoover says that there are in Europe today from twelve to fourteen million children between the ages of three and sixteen that are "bereft of parents, home, comfort, and the opportunities which should be their heritage". For every American dollar that is contributed the governments and the citizens of the afflicted regions will give two dollars in transportation and service. We can trust Mr. Hoover to make this

help practical and businesslike; he never wastes money and never asks for financial assistance without insisting upon supplementary contributions and co-operation from those most immediately related to the beneficiaries of his scientific charity. Of course, the amount of money asked for this noble purpose is small indeed if compared with the vast sums squandered by our people on luxurious living, for example, in candy, Christmas presents, and private automobiles. It will be raised without a doubt, and while it is being collected we may remind ourselves again of a part of our own responsibility for the unhappiness it will alleviate, since the failure of our Government to make peace with the governments of the countries with which we have been at war is one of the causes of the deplorable condition of continental Europe, especially the Central and Eastern regions. The poverty of the old world is the direct result of war and the preparation for war. Our own vast governmental expenditure is due mainly to the same causes; indeed, two-thirds of the money voted annually by Congress is absorbed in military and naval expenditures even during normal times. We hope Mr. Harding will carry out his promise to take the lead, in behalf of the United States, in a new effort to induce the disarmament of the nations and the creation of an association for preserving peace, and thereby save the world from untold pain and trouble.

The Flotation Litigation

In this issue we publish a comprehensive account of the present status of the litigation arising from the use and alleged infringement of various flotation patents in this country. The reading of this summary of the decisions and procedures of the courts will impress the members of our profession with the inadequacy of the tribunals before which such highly technical disputes have to be tried; they will note the discrepant nature of the juridical logic, the contradictory character of the opinions, and the fortuitous conclusions that seem to mark an appeal to the law. No man can foretell what the outcome of a suit may be, however well informed he may be concerning the facts and the arguments; the psychology of the human element in the judges is beyond the shrewdest guess; it is a gamble! Most wise men know this and keep out of the courts. So far the patent-exploiting corporation, Minerals Separation Ltd., with its American subsidiary, has had the best of it; but the defendants are not dismayed; on the contrary, as we are informed, they feel cheerful over the probable outcome of the concluding stages of the litigation. In our rôle of observer we venture to say that the defendants are better served in the matter of legal talent than heretofore, when they have suffered from mistakes that it did not require a lawyer to detect. However, the eventual result of all this legal wrangling is one that no man can predict, it is in the lap of the gods, that is, it is dependent upon the digestion of sundry fallible mortals. Meanwhile a suggestion for a compromise and a settlement has been made; we made it ourselves at the Flotation Con-

ference of the American Mining Congress. Since then the president of the Congress, Mr. W. J. Loring, has acted upon the offer, made by Mr. Alfred A. Cook, counsel for Minerals Separation, to meet with a committee of the Mining Congress, with a view to discussing the remedies possible for meeting the difficulties and ameliorating the irritating conditions created by the methods, practices, and license agreements of Minerals Separation in their impact upon the mining industry. Mr. Loring has appointed Messrs. Bulkeley Wells, J. Parke Channing, Gilbert H. Montague, with himself, ex officio, as the committee for this purpose. Mr. Wells was president of the Congress last year, he is the head of a number of important mining enterprises, in Colorado, California, and Nevada; Mr. Channing is vice-president of the Miami Copper Company and is identified with the mining operations of Adolph Lewisohn & Sons; Mr. Montague is a distinguished lawyer of New York and counsel for the Mining Congress in its complaint against Minerals Separation before the Federal Trade Commission; Mr. Loring himself is a mining engineer of international reputation and is the manager of important mines in Nevada and California. The committee, therefore, is representative and capable. In order that there may be no misapprehension as to the purpose and scope of the inquiry to be made, we quote from the final telegram sent by Mr. Loring to Mr. Cook, as follows: "American Mining Congress Committee does not ask Minerals Separation to admit correctness of charges or criticisms before Federal Trade Commission. Committee does not desire to discuss with Minerals Separation these or any other charges or criticisms. Committee most earnestly desires to discuss constructively with Minerals Separation any specific measures for relieving present situation. You offered at Denver to take up with us the various problems we think are oppressive to the mining industry. This is the exact purpose for which the Committee understands the conference is to be held." Mr. Cook replied that he and his associates would be "most happy" to meet with the Committee on the basis of this telegram. We hope that the outcome will inure to the benefit of the mining industry. It is not within the scope of this committee, so far as we can infer, to attempt to bring about a settlement of the main issue; indeed, it may be beyond the power or goodwill of anybody to do so, but evidently it would be greatly to the benefit of the mining industry if this miasma of inquisition, interference, and litigation could be lifted. As to that, any such consummation will be in the nature of a compromise, that is, on the one side, the Minerals Separation people will have to forego their claims for punitive damages from the alleged infringers of their patents, and, on the other side, those who have used flotation processes claimed to be patented by Minerals Separation will have to pay something rather than leave the ultimate decision to the courts. Whatever the outcome of the litigation, it is going to cost at least \$250,000 per annum for each side, and the final result is uncertain. The alleged infringers may escape some of the penalties imposed by the courts, but not all; they may be mulcted

for millions of dollars. The Minerals Separation people have been trying for nine years to squeeze money out of the recalcitrant users of their patents and have failed to bring them to their knees; the principal proprietors have seen their expected profit put out of their reach again and again, and meanwhile they must be aware of the fact that so long as the basic principles of flotation remain a matter of conjecture among physicists and chemists, so long will they be exposed to the danger of a discovery, to be converted into a patent, that may set aside and override all the advantages they now hold. These are far-reaching considerations, and we doubt whether the committee appointed by the Mining Congress will care to go into them. However, we cherish the hope that these and other matters pertinent to the controversy will be duly considered and that the meeting of representatives from the opposing camps will lead to a better understanding all round, preparing the way for an armistice, and possibly for a peace, with reparations.

The Institute as a Publisher

The affairs of the American Institute of Mining and Metallurgical Engineers are the affairs of the American mining profession, so we need hardly apologize for discussing them. We are prompted to do so by several protests received by us against the recent "voluntary subscription", which is set down as one of three items on a bill for dues. We publish one of the letters received by us; it is from a distinguished member of the Institute. This year, instead of a simple bill for the dues, namely \$15, each member is debited with \$2 for binding, whether he wishes volumes LXV and LXVI bound or not, and at the same time he is told that even volume LXIV has not been issued and cannot be issued until next year. The date of the circular is December 17. Next, he is put down for a "voluntary subscription" of \$10, making \$27 altogether. At last week's meeting of the San Francisco section of the Institute this subject was debated. We were not present, but it is reported that a resolution was passed unanimously, by 50 or more, calling for the appointment of a committee to investigate the expenses of the Institute and devise plans for reducing them within the limits of income. Captain J. C. Ray, who said that he had been absent from all the meetings for three years and had only just returned from military service abroad, made the remark that there was much talk about the desirability of having engineers in the Government administration because their training would enable them to introduce economy and efficiency; yet the first thing he heard on his return was this request for a contribution of \$10 to make good a deficit caused by the failure of the engineers to run a business that was entirely under their control. This seems to us a just remark, even if unpalatable to most of us, but in the long run it is wise to face unpleasant facts honestly. In a recent circular the Finance Committee explains that the funds of the Institute have been exhausted by its enlarged activities and the great increase in the cost of publishing, printing, supplies, and salaries. A tentative budget for 1921 in-

dicates a deficit of about \$20,000. The directors believe that the present high costs are temporary and they feel that the activities of the Institute should not be curtailed. This is not a cheerful story, nor is it by any means unique, for many other organizations are feeling the effect of high prices and possibly the results of their own extravagance during an expansive period. It has seemed to us often during recent years that the Institute has become too exuberant in its publishing activities. Its Transactions have been voluminous to excess; they exhibit a lack of revision; if properly edited their bulk could be decreased 30% without loss to their value as technical literature; when received a considerable proportion of them goes into our waste-paper basket almost of their own accord. It seems to us that the Institute has been publishing a good deal of half-baked material, swelling the Transactions into two and even three volumes per annum, instead of the one compact well-edited book we used to receive when Dr. Raymond was editor and secretary. Not content with expansion in this direction, the Institute has seen fit to publish a monthly magazine, partly to serve as an official organ and partly to extend its commercial activities. Here it is proper to interject that the Institute magazine is in no sense the competitor of any technical journal, such as the 'Mining and Scientific Press' or the 'Engineering and Mining Journal', and any criticism of it is without prejudice. For example, the January number of the Magazine is just to hand, and we confess with regret that we can find nothing in it that is worth the price of paper, printing, and postage. The chief feature of the issue is an article on economic conditions by Mr. W. R. Ingalls. This is good, but most of us have already read Mr. Ingalls' views on the subject in 'The Annalist', the 'Mining and Scientific Press', and other periodicals. The account of the Engineering Council dinner is interesting to those who participated, but to few besides. This applies also to the chronicle of society activities, namely, those of local engineering organizations. Five pages are given to abstracts of papers to be presented; not one of these is of any such immediate importance or general interest as to justify its being printed more than once, in pamphlet form for the meeting, and later in a bound volume. Six pages are devoted to abstracts of important papers in current periodicals. These also fail to justify the publication of a 100-page magazine. Then comes a list of new members and of additions to the Engineering Societies Library, with other odds and ends. The Magazine is not worth the price it costs; everything in it that is essential could be sent to members in an 8-page folder; it seems to serve as an editorial kindergarten for a number of young men in the Secretary's office, thereby diverting energies that are badly needed for the Transactions. If the Institute is to remain solvent it had better curb its use of paper, printing, and postage, that is, cut down its effusiveness as a publisher. It is time for the directors to face facts and consider seriously what are, and what are not, the functions of a professional society such as the Institute. As to that there will be various opinions. We venture to express one of them.

DISCUSSION



Ex-Soldiers and Prospecting

The Editor:

Sir—In your issue of December 11, 1920, I notice a short editorial which commends Government assistance to returned soldiers in order to enable them to go prospecting for minerals. Such a scheme, which you say the Government of Western Australia reports as being successful there, is in operation also in British Columbia, but all reports of its success would be more complete and interesting if they stated for whom the prospecting was "successful".

Those schemes, which have been quite widely boosted of late in nearly every mineral country in the northern half of America may be highly "successful" from the point of view of some mining engineers and the companies they represent, because they are interested in keeping the market continually flooded with vast numbers of mineral prospects, so that a few of the best of them can be picked out and purchased for little, or nothing if possible, but they do not look quite so "successful" to the professional prospector who has spent the best years of his life and every dollar he could earn in the meantime in the hills looking for and developing prospective mines, nor will they appear very "successful" to the returned soldier prospector by the time he has acquired a tithe of the experience of the old professional prospector, who is usually altogether too inarticulate for his own good.

Some of the reasons why prospecting for most minerals is likely to be very unsuccessful to the man who actually does the prospecting are as follows:

Because there is no demand at present for any of the metals, excepting gold, and even that, unless the prospector is lucky enough to find it as a shallow alluvial deposit or as an absolutely free-milling quartz deposit, so that he can make it productive by his own efforts, will not do him much good, for the simple reason that otherwise he will be left with a white elephant on his hands, like the thousands of other claim-owners, many of whom have good likely-looking propositions near existing lines of transportation, which they are unable to work for themselves from lack of modern machinery or the means to buy it, and therefore must hold indefinitely or sell at their (the companies') figure to the mining companies that have the necessary capital and know it and take advantage accordingly, for every experienced mining man knows that hardly ever does a prospector who is fortunate enough to find a really good prospect, which soon develops into a mine, get enough for it to adequately

repay him, for the risks he has taken, the time and money he has spent, the disappointments he has endured, and the sacrifices he has made in order to find it.

As I pointed out to the British Columbia government over a year ago, if their intention was to benefit the returned soldier and incidentally mining, it would be much more sensible to develop a few of the best of our many thousands of already discovered but undeveloped prospects, many of which belong to returned soldiers, than to spend public money and the time of young soldiers looking for more mineral claims, raw and undeveloped, of which we have far too many already; and I feel confident that true conditions are much alike in all the mining regions.

The fact is that no government or individual can conscientiously recommend young soldiers or anyone else to prospect for minerals under present conditions, excepting, of course, 'hoochite', which you so humorously described a few numbers back, as hoochite solution always is in demand at high figures wherever humans congregate.

DONALD C. SIMPSON.

Smithers, B. C., January 5.

The North Star Mines

The Editor:

Sir—In the interview about the North Star mine and mill of Grass Valley, California, in your issue of December 25, 1920, you omitted, no doubt through oversight, to mention any of the details of John Hays Hammond's connection with the property in the early days, and to whose efforts was due the resuscitation of the famous mine and making of the property a producer of promise, before James D. Hague and Arthur De Wint Foote became connected with the company. During that period, and when the mill was being constructed, I happened to examine the mine, in a general way, and recommended it to Hamilton Smith, then in London, for the Exploration Company of London, with which he was prominently connected.

The mine had been shut down and was under water for about ten years, when it was brought to Hammond's attention by Alexander Stoddard, general agent of the New York Underwriters Agency. He and Hammond's friend, W. B. Bourn, of San Francisco, owner of the famous Empire mine near-by, became interested, on Hammond's recommendation, in supplying the money to re-open the property. At the time of the Hammond examination, there was little or no ore visible in the accessible workings down to about 1000 ft. on the incline.

The vein had been faulted and the surface plant removed. Under the Hammond regime, the workings were unwatered, the incline shaft sunk, and drifting and cross-cutting carried on. New ore ground was rapidly opened up, and an old stamp mill was leased, about one mile away. The proceeds of this small plant soon enabled a more extensive development plan to be carried out, and a new 30 stamp mill was erected. About this time Hammond was general manager of the undertaking. At this stage in the company's affairs, Hague happened to be visiting Hammond at Grass Valley, and was enabled, through Hammond, to purchase the controlling interest in the company from Bourn and Stoddard. Hammond remaining manager and consulting engineer, but later devoting himself to the development of the Bunker Hill & Sullivan, in Idaho. The period in point was an interesting as well as critical chapter in the history of this great Grass Valley gold mine, and there was then call for some real mining courage and sagacity, to re-discover the mine, as it were, and put it on the way to future success.

New York, January 4.

F. G. CORNING.

[The main subject of the interview was Mr. Foote and his career, not the North Star mine.—EDITOR.]

Rich and Poor Zones

The Editor:

Sir—The interesting and inspiring contribution of W. J. Loring relating, in your issue of November 27, his experience of finding poor zones and enrichments alternating with each other in the Plymouth Consolidated, brings to my recollection a remark, made to me personally, regarding the early history of the Great Boulder mine in Western Australia, by Richard Hamilton, the manager, who has, with such pronounced success, continuously guided the fortunes of that famous property almost since its discovery some seven and twenty years ago.

"When we went below five hundred feet," said Mr. Hamilton, "I really believed that the bottom had dropped out of the mine and my fears continued until we reached the 1200-ft. level, where an orebody was discovered almost identical with that which we had been working above." And so, by operating on a sound policy of maintaining development work well ahead of milling requirements, rich zones continued to be disclosed in sufficient number to compensate, in a large measure, for what, by comparison in value, might appear to be disappointments. The result is that the mine has flourished and, all these years, continued to furnish its fortunate shareholders with consistent dividends.

Even the old Lake View Consols mine, of Westralia's ton-of-gold-per-month fame, which reached a depth of 1950 ft. at the time when I was superintendent and which then disclosed no ore of payable grade below the 1750-ft. level, is, once again apparently, showing some signs of renewed hope and encouragement. Five winzes, each from 50 ft. to 150 ft. deep, have been sunk below the 2100-ft. level, at present the bottom, and, according to

latest report, assays as high as \$20 per ton (not in present-day currency but in real old-time metallic money) have been obtained, attractive enough to cause a resumption of sinking the main shaft to 2300 feet.

After all, a mine with a successful past must be considered of greater value than the result of sampling its lowest poor level would really indicate.

W. E. SIMPSON.

Boston Creek, Ontario, January 6.

Institute Affairs

The Editor:

Sir—At a time when an earnest effort is being made to persuade engineers to participate more actively in public affairs in order to ensure that public business shall be administered efficiently, it is particularly unfortunate for a great engineering society to be so mismanaged as to have its expenditures exceed its easily determinable income. One of the many sins which we charge up against the politician in his administration of public affairs is that he proceeds without any proper budget system.

The first thing which the Institute should do is to see to it that its officers cut down expenses until they come within its income. The deficit has not been created by the membership. The responsibility rests with the directors, who should be held personally responsible for the policy which they have pursued. The suggestion that \$5 should be considered as payment for the monthly publication, 'Mining and Metallurgy', is particularly unwelcome, as there seems to be no excuse for this publication. The technical press has always served the profession to its great satisfaction. Any matter which the Institute wishes to put before the public could be equally well or better presented through the regular journals of the profession.

All that the rank and file want of the Institute is the regular publication of carefully edited technical papers. If the editorial and publishing function were wisely discharged, the number and size of papers could be kept within reasonable limits, the monthly magazine would be entirely suppressed, and no deficit need exist.

Our profession should not be degraded to a condition of meeting expenses by passing the contribution-box, and our debasement is only added to when the Secretary asks for subscriptions which will, if paid equally by all members, amount to several times the amount necessary to be raised.

It is more than ever apparent that we need so thorough a house-cleaning in the New York office as will so completely remove the beam from our own eye that we shall have a right to assist in removing the mote from the eye of public business.

A MEMBER.

Palo Alto, California, January 14.

STATISTICS show that exports of oil from Mexico for the month of October totaled 17,300,000 barrels as compared with 8,060,000 barrels in January 1920. These figures are striking in view of the fact that in 1901 Mexico shipped out only 10,345 barrels.

The Present Status of Flotation Litigation

By T. A. Rickard

INTRODUCTION. In our issue of April 14, 1917, I told the story of the litigation arising in the Federal Courts out of disputes over the validity and scope of the patents owned by Minerals Separation, Ltd. At that time the Miami case had just been adjudicated by the Circuit Court of Appeals at Philadelphia, and the Supreme Court had disposed of the Hyde case. Since then the suit brought by Minerals Separation against the Butte & Superior Mining Co. has dragged its slow length through the three courts to final adjudication by the Supreme Court. This case may be regarded as a necessary sequel to the Hyde case. Meanwhile the Miami case has not yet gone to the Supreme Court; it is in the accounting stage, before a Master in Chancery, but it is expected that after the Master has reported finally, this case eventually will be submitted to the Supreme Court.

Two fresh suits have been started by Minerals Separation, namely, against the Nevada Consolidated Copper Company and the Magma Copper Company, the first operating at McGill, in Nevada, and the other at Superior, in Arizona.

BUTTE & SUPERIOR. This case was tried first before Judge Bourquin in the District Court of Montana and a decision was given on August 25, 1917.¹ The trial lasted from April 18 to May 15. The Court upheld the validity of patent No. 835,120 and the Butte & Superior Mining Co. was declared to have infringed this patent. It was found that throughout the period of infringement the defendant's process always involved the use of "a pyramid machine of seven cells in series, each cell containing a revolving perpendicular spindle and horizontal blades, and having two opposed spitzkasten". The result was violent agitation. At certain points in the flow-sheet here were, it is true, Callow or pneumatic cells, but at all times the pulp was first subjected to the rapid rotary agitation as described.

As to whether, after January 7, 1917, the addition of petroleum oil, to bring the total mixture to more than 1% of oil on the ore, took the defendant's operations outside the scope of the patent, the District Court decided that the petroleum oil added in the mixture "if not inert is ineffective, wasted, and injurious to the process and results", and that the pine-oil, used in substantially the same proportion as during the admitted infringement before January 7, 1917, was performing the same function as before; therefore, the substance of the patent having been taken, the defendant could not escape the consequences of infringement.

An injunction and accounting were ordered by the decree of the District Court, but the injunction was

stayed pending an appeal. This appeal was argued at San Francisco, before the Circuit Court of Appeals, on March 8, 1918,² and a decision was given on May 13, 1918.³ The Court was not the same as that which had heard the Hyde case, for Judge Gilbert was absent, but Judge Ross, who wrote the opinion in the Butte & Superior case, was one of the three who had sat in the Hyde case. The chief question considered was the proportion of oil used in the process covered by the patent. The majority of the Court, Judges Ross and Hunt, appear to have been impressed by a colloquy⁴ that took place between W. H. Kenyon, of counsel for Minerals Separation, and Justice McReynolds of the Supreme Court during the argument of the Hyde case. In consequence they held that the Supreme Court intended to limit the patent to five-tenths of 1% of oil on the ore, that being, in their opinion, the critical proportion that the Supreme Court had in mind when holding patentability to reside, among other things, in the use of a specific amount of oil "having a preferential affinity for metalliferous matter". Judge Morrow dissented, his opinion being that the patent was limited to 1% of any oil or oily liquid, and that the use of oil "in a quantity amounting to more than a fraction of 1%" was not an infringement upon the plaintiff's process.

This case was then taken, by writ of certiorari, to the Supreme Court, which gave its decision on June 2, 1919. The opinion⁵ was written by Justice Clarke, as in the Hyde case. The Court held, against Judge Bourquin, of the Montana District Court, that "petroleum and petroleum products are oils useful in this process of the patent", and it agreed with the minority opinion of the Court of Appeals limiting the scope of the patent to 1% of oil. I quote the last paragraph of the Supreme Court's decision:

"It results that the decree of the Circuit Court of Appeals that the respondent infringed the patent only when using one-half of 1% or less of oil on the ore must be reversed, and that its implied holding that the use in excess of 1% on the ore did not constitute infringement must be sustained. The case is remanded to the District Court for further proceedings in conformity with this opinion."

It will be remembered that the Butte & Superior company increased its use of oil to more than 1% after Jan-

²A description of the proceedings appeared in the 'M. & S. P.' of March 16, 1918.

³The full text of the decision will be found in the 'M. & S. P.' of May 25, 1918.

⁴See p. 379 of 'M. & S. P.' of March 16, 1916.

⁵See 'M. & S. P.' of June 21, 1919.

¹The opinion was recorded in full in the 'M. & S. P.' of September 29, 1917.

uary 7, 1917,* that is almost immediately after the Supreme Court's decision in the Hyde case. The same Court now held that the company, by which Mr. Hyde had been employed professionally, had infringed the patent only when it used oil in the proportion of less than 1%. In arriving at its decision, the Court made the following findings:

1. That the new evidence was too meagre in amount and too unsatisfactory to modify the Court's conclusion in the Hyde case on validity.

2. That except as to the proportion of oil, defendant's methods were substantially those of the patent in suit, that is, as defined in the Hyde case, the agitation of the pulp "by beating air into the mass" so as to form "a peculiarly coherent" froth.

3. That petroleum products are oils "efficient and useful in the process", but not "as highly efficient" as pine-oil or other oils that in the record are called "frothing oils".

4. That the froth derives its power of flotation mainly from the inclusion of air introduced into the mass by agitation.

5. That the patent disclosure to which Minerals Separation must be limited is when a fraction of 1% of oil is used "in the manner prescribed".

6. That the term 'frothing oil' does not appear in the patent.

7. That "the patent is on the process, it is not and cannot be in the result", and the scope of the patentees' rights is limited "to the means they have devised and described as constituting the process".

These findings by the Supreme Court are important in their bearing upon further litigation. The idea of a frothing-oil† is rejected. So far as patent 835,120 is concerned, we have "oils, oily liquids, and oily substances having a preferential affinity for metalliferous sub-

stances". In this (Butte & Superior) case the type of operation considered was that of the Janney machine, in which violent agitation is obtained of the type of the Gabbett mixer. Naturally it was inferred by those using machines of the pneumatic type, such as the Callow cell, that they could escape the charge of infringement, for did not the Supreme Court state the essence of the patent in the following definition: "We have found that if a proportion of oily substance be considerably reduced . . . granulation ceases to take place, and *after vigorous agitation* [italics mine], there is a tendency for . . . metalliferous matter to rise . . . in the form of a froth or scum". Again, the Court said: "The froth or scum derives its power of flotation mainly from the inclusion of air bubbles *introduced into the mass by agitation*".

The Butte & Superior case was sent back to the District Court, in order that it might recast its decree in conformity with the decision of the Supreme Court. An accounting was ordered and an account was filed before Judge Bourquin by the defendant. Exceptions were taken thereto. At the same time Minerals Separation petitioned the District Court to adjudge Butte & Superior guilty of contempt for having violated the injunction issued by the Court, the contention being that Butte & Superior was *not* using more than 1% of oil mixture per ton, because a portion of the oil was returned with the middling to the head of the flotation machine from the fourth to the seventh Janney cells. After a hearing (in February 1920) Judge Bourquin dismissed the contempt petition, holding that this question had not been decided by the Supreme Court and that he therefore could not adjudge contempt upon a question that had only been half litigated by the plaintiff. Nevertheless, this is an important point, for, in most milling operations, a varying portion of the oil is re-used. The accounting in this case is still pending, no testimony having been taken as yet.

MIAMI COPPER COMPANY. This case was decided in the Circuit Court of Appeals at Philadelphia on May 24, 1917. The majority opinion was that the three patents in the suit, No. 835,120, No. 962,678, and No. 1,099,696 were valid and had been infringed.† The minority opinion held that the first patent had not been infringed by the defendants' operations except when using the so-called first method. This case is rendered interesting by the fact that the Miami company used four methods successively; in the first it used a standard Minerals Separation machine; in the second, a centrifugal pump, a breaker in the circuit, a Pachuca tank, and Callow cells; in the third a Pachuca tank and Callow cells; and in the fourth a bucket-elevator and Callow cells. The fourth did not appear in the record, the majority opinion concerning itself only with the three previous methods, all of which it adjudged to have infringed patent No. 835,120. The main question was whether the agitation in the Miami mill was of the violent and persistent kind covered by the patent, the Court deciding that the centrifugal pump and the Pachuca tank together produced that kind of agit-

*In a statement dated November 22, 1919, and filed by the Butte & Superior company on the accounting, the varying proportions of oil are given in detail. From September to December 1915 less than $\frac{1}{2}\%$ was used; from January 7 to January 29 the percentage was well above 1%; from January 30 to February 9 it was less than 1% but more than $\frac{1}{2}\%$; from February 12 to March 31 it was again in excess of 1%, and so on. An interesting question arose, Minerals Separation insisting that the oil in the circulating load should not be included when determining the proportion of oil used vis-a-vis the patent. The oil in circulation, which is returned to the head of the mill, amounts to several pounds per ton on the ore. The Minerals Separation people contended that the Butte & Superior was in contempt of the injunction because it has added only 18 lb. of fresh oil during certain periods, and that the proper interpretation of the Supreme Court's decision required the addition of at least 20 lb. of fresh oil in the process in order to escape infringement. Judge Bourquin, of the Montana District Court, decided that there was no proper justification for the contention that the Supreme Court had so decided and advised Minerals Separation to appropriate subsequent procedure in the case with a view to having the question determined. The answer hinges upon effectiveness of the oil in circuit, and as to that there seems to be little doubt among those using the process.

†It is not an oil that froths; it is an oil for making froth.

†See 'M. & S. P.' of June 16 and 23, 1917.

tion. The fourth method, from which these devices were omitted, was not discussed because the Court "cannot consider and adjudge with propriety or authority a process with respect to which the plaintiff has had no opportunity to produce testimony and which was not embraced in the decree [of the District Court] we are reviewing". This was unfortunate for the Miami company, which, since the case was first tried in the lower Court, has discarded the infringing devices. The company managed its case badly, for the real name of the Pachuca tank is the Brown agitator, and to contend that the passage of the pulp through a Pachuca did not 'agitate' was unwise.

Since this case will be referred again to the Circuit Court of Appeals, and possibly to the Supreme Court, after the Master makes his report on the methods that have been used in the Miami mill since October 1, 1915 (the date at which the third method was discontinued), it is well to analyze the majority opinion, by Judge Woolley, because, obviously, it bears upon the highly important question whether aeration of the pulp through a porous medium, as in the Callow cell, constitutes infringement of No. 835,120.

It is to be noted, in the first place, that the Court of Appeals, following the Supreme Court in the Hyde case, overruled the District Court when it said that the patentability of 835,120 resides in the mere diminution of oil. Judge Woolley interpreted the Supreme Court's decision as finding patentability in the co-action of a specific proportion of oil and a special kind of agitation, the air bubbles being introduced into the pulp "by an agitation greater than and different from that which had been resorted to before". The Miami company admitted the use of less than 1% of oil and that the lifting force in its three methods was air; the issue therefore was whether the agitation it produced was "greater than and different from" the prior art. It was admitted that a froth was formed, but it was denied that it was the same kind of froth as that of the patent or the product of the kind of agitation described in the patent.

Setting aside the first method employed at Miami as being obviously experimental, it will be noted that in considering the second method Judge Woolley decided that the centrifugal pump sucked air and that the blow of the pump-paddle produced the agitation of the patent as to violence if not duration. He found some aeration resulting from the splash of a break in the circuit; likewise he found agitation and aeration in the Pachuca tank. In normal operation of the second method the pulp did not come to rest in the Pachuca but was delivered by launders to Callow cells. The Court found that the entrance of air through the porous medium at the bottom of the Callow cell caused some measure of agitation but it was "not even approximately of the violence and duration of the agitation of the patent". The Court proceeded to say that the defendants had argued the case largely as though its process consisted solely in passing thoroughly mixed but quiescent pulp directly into Callow cells, where it received its first and last aeration without previous or present agitation, resulting in a metallurgical

froth quite different from that of the patent. Judge Woolley could not find that the record justified this argument; he said:

"If the only agitation to which the pulp was subjected (after such agitation as in the prior art was necessary to mix the oil and ore) was the agitation of the Callow cells, we would not say that that agitation amounted to or was the equivalent of the violent agitation of the patent disclosure and constituted infringement; . . . the Callow cells were not the whole process but were merely the last of four distinct parts of the process, the other three being the process of the patent or its fair equivalent. Having used the process of the patent in the first three steps [centrifugal pump, break in circuit, and Pachuca] in developing in the pulp the potentiality of the critical quantity of oil and air, and in bringing the pulp to the point where, if permitted, it would produce the result of the patent, we feel that the defendant cannot escape infringement by taking an additional step, even though that step if taken alone avoids the patent."

The foregoing quotation is the crux of the decision by the Court of Appeals in the Miami case; it shows what a blunder was made in adopting the unnecessary use of the machines that infringed the patent, for the Court, referring to the patentees, said that "agitation was the secret by which the principle of their discovery could be unlocked and used".

In the third method, the centrifugal pump and the break in the circuit were omitted, the Pachuca being preceded by a bucket-elevator, which performed the function of the centrifugal pump in raising the pulp. The oil, it is true, was added ahead of the elevator, but, without commenting upon the action of the elevator, the Court held that this method also involved an agitation similar to that of the patent and therefore constituted infringement.

The second and third methods were discontinued in September 1915, four months after the submission of the case to the District Court, just one year before that Court handed down its opinion, and twenty months before the Court of Appeals pronounced its decision. For most of the time between October 1, 1915, and May 24, 1917 (the date on which the Court of Appeals issued its decision), the Miami company used the fourth method, consisting in the employment of the bucket-elevator, launders, and Callow cells, the mixture of oils being added at the foot of the elevator. Although the flow-sheet of this practice was before the Court in the form of a blueprint and the questions involved in these operations were argued at length, the Court felt itself restricted by the record so that it could not "consider a process with respect to which the plaintiff had had no opportunity to produce testimony, and which was not embraced in the decree under review". Had the Court been of the opinion, as has been argued by Minerals Separation in later proceedings, that the second and third methods were of such scope as to include the Callow cell, there was enough in the record to warrant a consideration of this question. In discussing the third method, the Court reproduced in

its opinion the blueprint mentioned above and described an experiment in which one part of the Miami mill was operated by the third method and another part by the fourth method. The Court said:

"In the experiment, one group was operated with the Pachuca tank as planned. In the other, the Pachuca tank was cut out and the pulp conveyed directly from the elevator to the cells. The result was no apparent difference in the action of the pulp and little difference in the assays of the metal recoveries, that difference, curiously enough, being in favor of the group in which the Pachuca tank was not used. The evidence of the fact and of the effect of this experiment was not contradicted, except, perhaps, by the defendant itself, by returning at once to its previous practice of using both Pachuca tanks, and in pursuing that practice to a time beyond the trial. This fact places the 'Third Process' in the position of the Second, where we have found that agitation and aeration of the Pachuca tank is the agitation of the patent, and amounts to infringement."

From the foregoing it is not quite clear whether the Court held that the method without the Pachuca avoided infringement, although the reference to the contradiction of the experiment by the return to the use of the Pachuca might warrant such an inference. In the direct testimony and cross-examination there was an account of the operation on a milling scale of the elevator and Callow cells, precisely as described under the so-called Fourth Process, and it is unfortunate therefore that the Court held itself unable to adjudge this point, so vital to the suit, and to the legal status of the Callow cell under the first patent, No. 835,120. Moreover, the status of the Callow cell under the second (soluble frothing-agent, No. 962,678) patent was not discussed by either the District or the Appellate court in the Miami case. This is a curious omission. The Court of Appeals had considered the use of the Callow cell in connection with the first patent, and found it not trespassing upon the agitation of that patent; if a different measure of agitation was intended to be ascribed to the second patent, and there was lack of proof of the agitating effect of the bucket-elevator under either of the patents, it was open to both Courts to apply the measure of agitation of the second patent to the Callow cell and thereby determine where it came within the scope of that patent. The question of the action of the Callow invention was known to the Court of Appeals to be the important issue involved in the lawsuit, and if there had been any intention of bringing the Callow cell within the scope of the second patent, it was to have been expected that the Court would so express itself, instead of leaving this vital question undetermined. In default of a clear pronouncement on this point, it may be assumed that the Court meant what it said when it found the difference between the first and second patents to be in the character of the frothing-agent used, and that in the second, as well as in the first, patent "the decision turns

upon the kind and degree of agitation employed by the defendant". Since the third patent in suit is concededly an amendment of the second patent, it must be limited or fall with it.

After the decision of the Court of Appeals, in May 1917, the Miami company was given time to decide whether it would present a petition to the Supreme Court for a writ of certiorari preliminary to a further review of the case by the court of last resort, and, after due consideration, the defendant company concluded to accept the decision of the Appellate Court as being substantially, in its favor, any action in the nature of an appeal therefrom having the appearance of an attack upon that favorable decision. Accordingly in August 1917 the Miami company notified the Court of Appeals of its intention not to apply for a writ of certiorari, whereupon the mandate of that Court issued and the decree of the District Court was pronounced, together with an injunction restraining the Miami company from continuing the practices that infringed the patents in suit.

In accordance with the original order entered by Judge Bradford, of the District Court, the case was referred to William G. Mahaffy, as Master, to obtain an accounting of the profits derived by the Miami company in consequence of its infringing practices. Late in 1917 the Master ordered the Miami company to file its account, which was done in due course. Minerals Separation filed its exceptions to this account and thereby raised the question as to whether the milling practice subsequent to the first, second, and third methods, as considered by the Court of Appeals, was or was not a colorable departure from the declared infringements. In support of its contention that the later practice was merely such a colorable departure, Minerals Separation called as its witness R. B. Yerxa, assistant mill-superintendent to the Miami company, and examined him for 30 days in connection with the introduction of 80 exhibits, representing every milling and experimental operation performed in the mill from September 1915 to the date of the examination. Mr. Yerxa's testimony covers 625 pages. At the request of Minerals Separation, his testimony was interrupted in order to allow a visit of inspection to the Miami mill by the Master, with counsel and experts for Minerals Separation. This visit extended over four days.

On November 26, 1919, more than a year and a half after the taking of testimony had been begun before the Master, and after 2500 pages of testimony had been accumulated, Minerals Separation made a motion for leave to file a Supplemental Bill, the avowed purpose of which was to take from the Master the question whether the later operations of the Miami company were or were not infringing. Two months later, on January 27, 1920, the Court denied this request, on account of certain defects in the proposed Supplemental Bill, and at the same time indicated its opinion that the investigation into the later milling operations came properly before the Master.

On May 4, 1920, Minerals Separation filed its petition in the District Court, praying that the Miami company be adjudged in contempt, as having violated the injunc-

¹I have used 'method' instead of 'process', the former term suggesting more correctly a way of performing a process rather than a different process.

tion of the Court, and that a further injunction be issued to restrain the company from the practice it had adopted after discontinuing the so-called Third Process. On May 24 the Miami company filed its answer denying that the said operations were infringing and asking that the petition be dismissed. This motion was argued before the Court on June 15, and on July 23 the Court dismissed the petition for contempt. Judge Morris, of the District Court, in his opinion, stated that "in view of the nature of the new processes used by the defendant as charged by the petition . . . the plaintiff must obtain the relief to which it is entitled, if any, touching the new processes, either through the proceedings now being had before the Master and the decree to be entered thereon, or by a new bill, and not otherwise". On the same day therefore Minerals Separation made a motion for leave to file a Supplemental Bill, praying that Minerals Separation North American Corporation be made a party to the cause, and, although objection was made to this, the Court decided to grant the request, "but without prejudice to the defendant to renew its objections, in a manner when suitable, to the bill when filed, if it be so advised". An order accordingly was made on July 22. Four days later Minerals Separation asked for leave to file a second Supplemental Bill, the purpose of which was the taking of the investigation of the Miami company's later practice from the Master, and the trial of the same before the District Court. This was denied, on August 11, 1920. Thereupon Minerals Separation took an appeal on the two orders (of July 23 and August 11) to the Court of Appeals, and the Miami company filed a motion to dismiss the appeal, and this matter was set for argument at Philadelphia on November 9. A month later, on December 9, Judge Woolley pronounced the decision of the Court of Appeals, affirming the orders of the District Court and holding that the modifications or changes made by the defendant in its milling practice since September 9, 1915 were not plainly mere colorable equivalents of procedures that infringed. Judge Woolley held further that the practice of issuing supplementary injunctions is not to be adopted in the Third Circuit and that "the remedies against infringement after decree are those which now prevail, namely, damages and profits on accounting, attachment for contempt, and original bill; in the last the patentee's right to injunctive relief is fully preserved to him". The Court stated: "We have read and carefully studied the entire record . . . We shall not restate the law of the case, but shall address ourselves solely to the new facts. These embody at least eleven new procedures or modifications of procedures charged to be infringements because equivalents of the infringements found by this Court in its decree. The processes decreed to be infringements were made up of several steps in which it was found, speaking most generally, that infringements were completed before the pulp had reached the Callow cells. In none of the eleven modified processes, again speaking generally, is there a centrifugal pump or 'break in the circuit' or a Pachuca tank, means or steps held potential in the infringements found. In the

later modified procedures, Callow cells are employed exclusive of and inclusive with other means, in some instances with no prior agitation, in other instances with prior agitation without aeration, in still other instances with prior agitation and aeration, indicating agitation in degrees varying as greatly as the adjectives used in describing it; but whether in any of them there is agitation of the kind, in the degree, and for the duration contemplated by the patent is not so clear and unclouded as to make the newly alleged infringing procedures free from doubt and to warrant the extraordinary remedy of supplementary injunctive relief . . . To avoid the appearance of affirming the Court's decree upon the negative quality of a finding that we discern no error in its order, we go farther and say, that, having made the law of the case we are presumed to know what it is, and that, applying the law to the facts, which, on the defendant's motion to dismiss are regarded most favorable to the plaintiffs, we would have made the same disposition of the case had we been sitting in the District Court when the application for a supplementary injunction was made. We are of opinion therefore that the order or orders of the District Court should be affirmed and the case be proceeded with expeditiously and in a manner consistent with the law."

On May 26, 1920, the Miami company petitioned for leave to file a supplemental bill in the nature of a bill of review. The company took this step on account of the discovery of "an unpublished book in manuscript form", written by Messrs. Sulman and Picard in 1906. This treatise, a copy of which was found in the possession of T. J. Hoover,* to whom it had been given by the authors early in 1907, contained evidence tending to show that patent No. 835,120 was limited to a process of concentration in which less than 1% of oil was added to a freely flowing pulp and the mixture subjected to rapid rotary agitation, until the sulphide mineral formed in a froth. It was also the contention of the Miami company that this treatise, entitled 'The Theory of Concentration Processes Involving Surface-Tension', disclosed the point to which the art had advanced, as far as known to the patentees, prior to the alleged date of invention, and that this state of the art left nothing open to invention save the single element of the "whipping in" of external air by rapid rotary agitation. It is apparent from the treatise that Messrs. Sulman and Picard knew that froth had been produced in the Potter and Delprat processes without the use of oil, the lifting force being solely the gas generated within the pulp by the action of acid on carbonate minerals; that they were well aware of the fact that Froment had produced froth of the same character, in the same kind of process, with the addition of a proportion of oil so small as only to film the particles of mineral, so that the film, to all intents and purposes, became part and parcel of the particles themselves; that in the Elmore vacuum process the same kind of froth was produced by using a similarly small proportion of oil,

*M. Hoover's affidavit was published in the 'M. & S. P.' of June 19, 1920.

the lifting force being air drawn out of solution by the application of a vacuum; and, further, that the same result could be obtained in a process using the same small proportion of oil by passing a current of air through the pulp in the form of bubbles, as disclosed in the so-called bubble patent No. 793,808. The treatise indicates that the patentees, at the time (March 1905) of their supposed invention of the process covered by No. 835,120, were aware of all these facts, which limited their patent, in their own words, as a "mere practical application of the Froment principle", wherein air was introduced into the mass of pulp by whipping in external air by rapid rotary agitation. Thus the argument for the defence comes back again, much reinforced, to the one brought forward in the first trial of the Hyde case in Montana, eight years ago.

The Court denied this petition of the Miami company, but stated: "In so doing, we express no opinion as to the relevancy or competency of the subject-matter of the petition on questions arising on accounting." This apparently indicates the belief of the Court that the whole matter could be settled in the proceeding before the Master or in a new suit begun by an original bill, and that the proper way to introduce this new evidence was not in a re-opening of the original case but in the proceedings on the accounting, which, in the end, of course, will go back to the Court of Appeals, or be adjudicated in the course of a new suit under an original bill.

Meanwhile, although seriously impeded by the numerous attempts to cause the investigation into the later milling methods to be removed from the accounting proceedings, the Master has continued to take testimony, but as yet the *prima facie* case on the accounting has not been completed.

NEVADA CONSOLIDATED. On September 9, 1919, Minerals Separation North American Corporation and Minerals Separation brought suit against the Nevada Consolidated Copper Co. in the District Court of Maine, southern division, on patent No. 835,120. The defendant, in answering, raises the issue of validity and denies infringement. This case may be heard some time this winter. On February 16, 1920, Minerals Separation brought suit against the same mining company on patent 962,678 (the so-called soluble frothing-agent). The defendant again denies validity and infringement. It is expected that this case also will come up for trial during the coming winter.

It is interesting to note that in these Nevada cases the plaintiff is claiming that pine-oil has certain soluble fractions, and that the use of pine-oil constitutes an infringement of both patents, 835,120 and 962,678. It remains to be seen how Minerals Separation will square its present position with the testimony in the Miami case, wherein its expert, Dr. Leibmann, said that pine-oil, for all practical purposes, was insoluble, and it remains also to be seen how Minerals Separation will deal with the Supreme Court's decision in the Butte case where it was held that pine-oil was "an oil having a preferential affinity for metalliferous matter" within the description of patent

835,120. The legal definition of 'solubility' will be awaited with interest, likewise the juridical effort to distinguish between the use of the term in chemistry and in metallurgy respectively.

MAGMA. On January 10, 1920, the two Minerals Separation companies filed suit against the Magma Copper Company, also in the District Court of Maine, southern division. In this suit the same patents, 835,120 and 962,678, are involved. The defendant denies infringement and questions the validity of the second patent.

In this case, as in the Nevada cases, there will be presented squarely to the Court the question whether or not the Callow or other pneumatic cell is an infringement of either patent. In the mills of both companies the operations have been excluding any prior agitation other than is necessary to mix the oil with the ore, so that the agitation described in these patents, if present, must be found within the pneumatic cell. The decision in these cases ought to settle definitely the validity and the scope of the first patent, both as to the character of the frothing-agents and the meaning of the agitation prescribed in the claims. The validity of the patent for a soluble frothing-agent should be fought to a finish, and it should be ascertained what is a "soluble frothing-agent" and whether it is covered by the description of the oil of the first patent; and if not, we should be told the meaning of the phrase "agitating the mixture to form a froth".

As yet Minerals Separation has not brought suit against any other of the alleged infringers; the cases now pending raise practically all the important questions left in doubt by the precedent litigations, and while Minerals Separation may find it necessary to bring additional suits to prevent its rights from lapsing by limitation, it would appear certain that the decisions in the several cases pending should determine definitely the extent of the monopoly that Minerals Separation is to be permitted to exercise by law.

TO FACILITATE the development of the Flin Flon copper deposit in Manitoba, involving the building of a railway approximately 100 miles long, the erection of a mill and smelting plant at a cost of about \$3,000,000, and the development of water-power with 35 miles of transmission line at a cost of not less than \$2,000,000, the Canadian government has issued an Order in Council making important changes in the mining regulations. The regulation requiring that all ores shall be treated and refined in Canada is set aside, owing to the cost that would be involved in shipping the blister-copper for final treatment to the Trail smelter in British Columbia, and permission is granted to export blister-copper, the product of the mill and smelter, for a period of ten years unless in the meantime facilities have been established in Canada for the electrolytic refining of this product as cheaply and efficiently as elsewhere. It is also provided that products of the Flin Flon mine, in which the gross recoverable metal is valued at less than \$10 per ton, and are smelted in Canada, shall be exempted from royalty for ten years from January 1, 1921.



THE SOUTH LODE OF RIO TINTO, LOOKING EAST



THE SAME, LOOKING NORTH

Pyrite in the Huelva District, Spain

By Courtenay De Kalb

***INTRODUCTION.** Nearly the entire output of pyrite in Spain is derived from the province of Huelva. Out the copper production, which directly depends upon the operation of the pyrite mines, as follows:

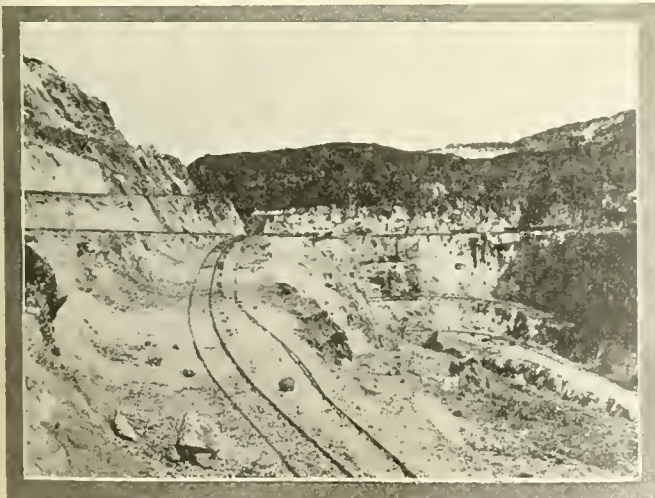
Copper Production of Spain, 1918			Corresponding		Total value, pesetas
Merchantable	Source	Kilogrammes	Pounds avoirdupois	tonnage of ore, metric	
Cement copper	Huelva, from leaching	22,642,381	49,813,238	1,745,796	65,555,868
Blister copper	Huelva	18,610,000	40,942,000		43,054,462
Cement copper	Sevilla, from leaching	799,000	1,757,800	15,201	937,400
Copper matte	Cordoba	1,453,000	3,196,600		2,074,500

of a total production, in 1918, of all classes of pyritic ores, which were valuable in part for their sulphur content, 1,597,675 metric tons, or 96%, came from that Province.

In addition to the foregoing, it is of interest to note

***Abstract from a report prepared for the Bureau of Foreign and Domestic Commerce, Department of Commerce, Washington.**

It may be well to mention at this point that the Rio Tinto mine alone, which is the heaviest single producer in the Province, was mining, in July 1919, at the rate of 5000 tons per diem, with a payroll embracing about 9000 men in all positions. Of that quantity, 4000 tons would be classed as sulphur ore, that is, it contained from 46 to 47% of sulphur. The remaining 1000 tons was highly silicious, but rich in copper, and did not



IN THE BIG PIT



SOUTH END OF RIO TINTO

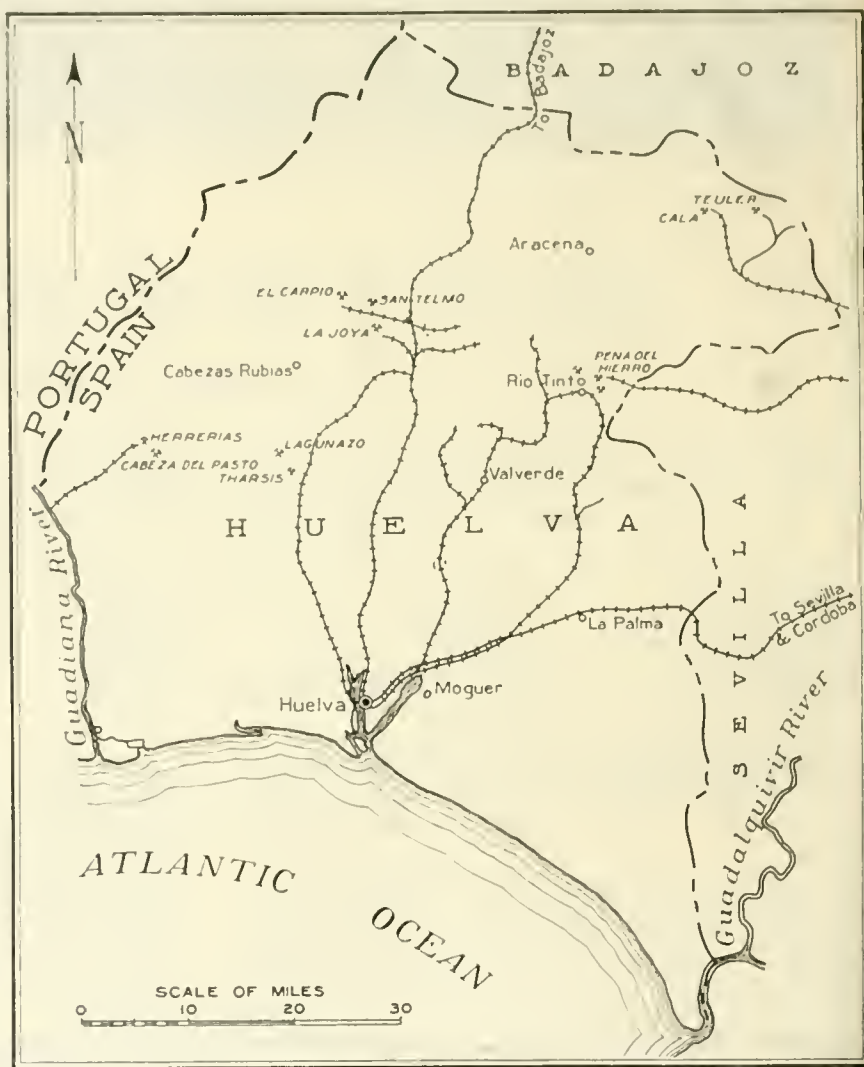
feared in the pyrite market. The Tharsis mine, near the centre of the Province, produces considerably less than the Rio Tinto, though it is now prepared to mine and ship 1,000,000 tons yearly.

In the Huelva district it is customary to mine large tonnages of ore, regardless of the existing demand in the pyrite market, and to store this in leach piles on the surface. As will be shown later, the copper is perfectly extracted, and at a low cost, by a method of leaching. At the same time the removal of this copper results in raising the sulphur content of the residual pyrite, rendering it superior as a 'sulphur ore'.

Following this system, therefore, and considering that, after the first few months, the cost of taking care of a leach-bed is reduced to a low figure, and also that copper in appreciable quantity continues to issue from a bed for periods as long as ten years, while pyrite remains essentially uninjured and loses a total rarely in excess of 10% of its weight by oxidation, it is apparent that storage does not represent a heavy expense. The cost of mining, including overhead charges, is repaid by the copper recovered in the first few years of leaching. Therefore it is not necessary to charge interest, except for a brief period, against the ore stored in the leach-beds. The copper recovered, even from the seventh to the tenth year, will pay a profit on the cost of taking care of the bed. Accordingly, the liquid assets of a company are increased by accumulating ore in this manner. While it remains in the mine it is a potential asset; when transferred to the surface it becomes a liquid asset as soon as it has been long enough in the bed to have yielded above 80% of its copper, with a corresponding increase in the proportion of contained sulphur. It is then ready for market as a sulphur ore. Whatever is obtained for the sulphur, and for the residual cinder, considered as an iron ore, above the cost of handling and transportation, appears to me a net return. This would probably be denied by the operating companies in Huelva, but investigation reveals the facts to be as stated. It is to the credit of the Province and of the producing companies that it is so. It displays the strength of their position. They can afford to wait for unfavorable market conditions to change, and in the end they will be found to hold a commanding position with reference to the production of sulphuric acid. In the last analysis the sulphur obtained by means of the unique system of ore-treatment in vogue at the mines of Huelva is as much a by-product as the sulphur that may be utilized in the fume at smelting works.

As a result of the peculiar character of the Huelva ores, which admits of their being mined and stored on the surface and of yielding a profit at the same time, it is advantageous for an operating company to accumulate such stocks. It pays to do so for the sake of the copper produced, regardless of whether the ore be sold for its sulphur content or not.

Stocks of Ore. I have endeavored to ascertain the amount of such ores now mined and stocked in the leach-beds in the province of Huelva. For the most part, such



THE PROVINCE OF HUELVA, SPAIN

figures are closely guarded; the total, however, appears to be not less than 25,000,000 tons, of which about 15% is clean leached pyrite, averaging between 47 and 50% sulphur, a large part of which is sufficiently leached to be ready for shipment; 40% is low-grade ore, averaging above 35% and below 40% sulphur, which will require to be concentrated before it can be sold as a sulphur ore and the remainder is above 20% and below 35% sulphur usually higher in copper than the high-iron-sulphur ores but which will probably never be used as a source of supply for concentration.

According to the official report of the Ministerio de Fomento, in August 1917, the Rio Tinto company ha

18,540,000 metric tons of ore stacked in the leach-piles.

Estimates of tonnages developed in the mines are almost impossible to obtain, the mine managers being reluctant to divulge such figures. At some of the smaller

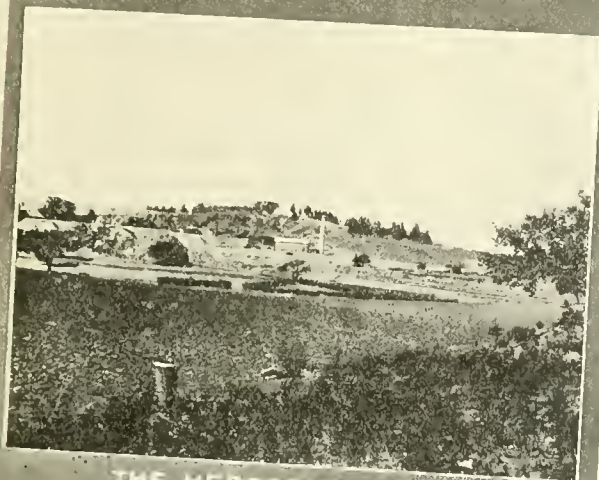
million tons developed; the Cuchichón (in the Sevilla portion of the district) is credited with 6,000,000. The reserves of the Tharsis company exceed 100,000,000 tons. The tonnages developed will enormously exceed the quantity mined and stored in the cementation beds. The total ore in sight, actually developed and ready for extraction, will apparently exceed 230,000,000 tons, of which 56,000,000 is in the Rio Tinto alone. The outlook for developing still greater tonnages in the Province is excellent. This will be discussed later.

THE PYRITE ZONE, within the province of Huelva, is 25 miles wide from north to south, and 50 miles long from east to west. It continues eastward into the province of Sevilla for at least 30 miles to the important mining town of Aznalcóllar. The zone also extends over 40 miles into the neighboring republic of Portugal to the town of Ajústrel. The pyrite area, therefore, is at least 120 miles in length. Throughout this zone is found an infinitude of diabase outcrops, constituting a parallel series. These intrusions are traceable continuously on the surface, but appear at intervals following the same general direction, having apparently been dikes that either reached the surface only at places, or have been disclosed by erosion at various points. The trend of these diabase dikes averages about N. 70° W., varying locally between E.-W. to N. 75° to N. 75° W. The orebodies conform to the direction of these dikes of basic volcanic rock, and are commonly associated directly with them, sometimes being found wholly within the basic rock, although for the most part they lie on the contact between the diabase and the enclosing slate.

The slate associated with the orebodies is of Silurian age in places, and in others sub-Carboniferous. The boundary between the Silurian and the Lower Carboniferous areas is usually not clearly defined, and fossils are rarely found, so that it is difficult to establish the identity of the geologic horizon. This is evidently of small economic importance. The famous Tharsis mine is in sub-Carboniferous slate; the Rio Tinto likewise, fossils being found at that point, especially at the San Dionysio workings; the La Joya San Telmo-Carpio group is in Silurian; the Herrerias and Cabeza del Pasto are on the indeterminate border-line between rocks of these two ages. It seems to exert no influence upon the ore deposition which formation the intrusive rocks penetrate, despite the fact that the sub-Carboniferous slate generally contains a considerable amount of carbonaceous material, which is frequently present in the form of graphitic zones of marked persistence, following the cleavage-direction of the slate. Neither at the Rio Tinto, nor at the Herrerias, 50 miles to the west, is unaltered or partly replaced slate found in the ore, but nodular masses of pyrite, identical in character with the main orebodies, are sometimes seen in the slate. On the other hand, along the south wall of the great orebody in the San Dionysio mine (Rio Tinto) porphyry tongues (apophyses) are seen extending to considerable distances into the slate. These are always highly altered and sericitized,



THE RIO TINTO



THE HERRERIAS MINE



LOADING ORE ON THE GUADALQUIVIR

mines the officials in charge admitted having developed tonnages ranging from 500,000 to 1,000,000. The Herrerias has 1,000,000, the Cabeza del Pasto is still more important; the Peña de Hierro probably has several

and often contain notable amounts of disseminated copper sulphide in the form of sooty and fine granular chalcocite. On the north wall, in contact with the volcanic intrusive rock, the boundary of the ore is not as sharply drawn as it is on the south side in contact with the slate, and the ore and volcanic rock are greatly intermixed, many veins and masses of pyrite being traversed before the main orebody is reached. There is also a great deal of sericite on the side adjoining the porphyry. This stands forth prominently on looking into the great south open cut, 500 ft. deep, at the Rio Tinto mine. The sericitized material clearly marks the limit of the orebody by a line of white, and also makes prominent the foot-wall along the south side of the terraced open-cut.

The intrusive rock crosses the slaty cleavage at a small angle, the slates always bearing more northerly. The slate has, quite independently of the planes along which it splits (fissility), developed two sets of joint-planes, one inclined toward the south and the other nearly horizontal. The slaty cleavage dips at an angle of nearly 60° from the horizontal, and this is crossed by a sub-cleavage or rift. The slaty cleavage generally dips toward the ore and the strike is more northerly than the trend of the orebodies.

According to George Wyndham Gray, superintendent of mining operations at the Rio Tinto, the so-called *ofitas*, or dioritic to diabasic rocks, are not derived from a basic magma, but represent altered segregated portions of acid magmas. As seen in the vicinity of Rio Tinto these dikes are greenish in color, like partly altered diabase, but Mr. Gray informs me that on penetrating them for some distance they prove to be hard silicious rocks of a 'felted' structure, and are not crystalline or fine-grained. The evidence at the San Dionysio mine indicates alteration from a basic rock (a point that can be definitely determined by microscopic examination of specimens), but I noted quartz inclusions in the form of rounded masses, such as frequently occur in quartz-porphyry. This, however, is not decisive, since these quartz inclusions are equally characteristic of the relatively basic dacite. I must defer to the longer study of the Rio Tinto deposit made by Mr. Gray, and it may be necessary to admit the association of this, the largest known pyritic orebody in the world, with volcanic rocks of an acid (silicious) type, but the least altered specimen that I was able to find between the San Dionysio and the north group of orebodies had the appearance of an altered silicified semi-basic rock.

It is an interesting fact that the iron deposits of Spain, whether existing as pyrite, as oxides, or as carbonate, seem to be associated universally with basic, and often with ultra-basic intrusions. This suggestion of a common genetic basis for most of the iron deposits of Spain is open to question, but careful study of the entire area will, I believe, demonstrate that such a hypothesis is worthy of consideration. It is noteworthy that on going northward from the centre of the pyrite belt in Huelva the proportion of iron in the ore-forming solutions ap-

parently has been progressively greater than the sulphur, while the copper has remained rather uniform. Thus, at the Cala mines, and at the Teuler a few miles farther north east, are found great masses of magnetite replacing diabase, with irregular aggregations of pyrite and chalcopyrite, which at places bring the material within the classification of pyritic ore, as which it is reported in the statistics of the Consejo de Minería. Proceeding northward, the iron ores of Badajóz and Cáceres are found, with only moderate quantities of pyrite disseminated through them. I believe that the pyritic orebodies of Huelva, Sevilla, and south-western Portugal may represent one phase of a general phenomenon that is observed over the larger part of the Spanish peninsula where the intrusion of basic rocks has resulted in the formation of great iron orebodies.

At the Rio Tinto the deposition of ore has taken place on an enormous scale, and extensive gossans existed as a guide for the early miner. The alteration has been so profound that it is extremely difficult to obtain a sample of the igneous rock accompanying the ore that is fresh enough to admit of identification in the field. Proceeding westward, the outcrops of the orebodies become more and more obscure, until, at the Herrerias, no outcrop at all is seen, and the existence of ore is indicated on the surface only by faint lines of discolored material, whitish, yellowish, pinkish, and often with small discontinuous outcrops of quartz veinlets containing casts of pyrite crystals, and occasionally with some remnants of unchanged pyrite. It was upon such indications that the original exploratory shafts at Herrerias were sunk. The first shaft, which reached a depth of about 200 ft., failed to disclose any ore, and a cross-cut, which later proved to have come within 15 ft. of the upper end of a powerful orebody, also gave negative results. Subsequently an English company followed the indications of the lode westward, about a mile, to a prominent brilliantly iron-stained hill, known as Cerro Colorado, and expended at this point about \$400,000 in a vain search for ore. Undeterred by these failures they returned to the Herrerias and sunk a new shaft, on the north side of the zone of lode-indicators, this time meeting with encouragement by finding small masses of ore at intervals until the great body of solid pyrite was disclosed. After some further exploration it was thrown into an open-cast mine, following the example of the Rio Tinto. It has today a million tons of ore developed, and half as much in the cementation yards in process of leaching.

A matter of peculiar geologic interest is disclosed at the Herrerias, which may have a bearing upon the genesis of these pyritic deposits in general. Toward the east end of the property is a cross-cut 20 ft. deep, serving as an exploratory trench across the faintly indicated lode. It begins, on the north side, in a dark close-grained igneous rock, consisting mainly of labradorite and pyroxene, that would be classed in the field as an andesite. Proceeding southward this soon alters to a greenish granular rock, exhibiting the characteristics of

the so-called 'porphyry' at Rio Tinto. This continues for 20 ft., and is succeeded by a pale yellowish rock, also fine-grained and noticeably porous, with faint iron-oxide staining in the open spaces. Following this, southward, is a mass of highly ferruginous material, with abundant iron hydroxide. Much of it would apparently contain no less than 30 to 40% of metallic iron. In the altered portions of this dike is much sericite, and it is conspicuous that the slates on the south side of the lode are usually converted into sericite schist to a distance of three to six feet. I observed the same phenomena in the lower levels of the San Dionysio mine at Rio Tinto.

As another fact of observation, I may record that in the Herrerias mine the cross-cuts driven into the slate reveal seams of quartz and also of calcite, the latter often occurring in parallel veinlets, close to the orebody, but the superintendent, Alphonse Perbas, informed me that calcite has never appeared in the ore itself, although quartz masses are not infrequent. The slates, furthermore, have lost much of their slaty character near the lode, and outside of the sericitized zone they generally, according to my observation, present a granular facies for some distance.

Another interesting feature was the existence of belts of purple slate, very hard and lustrous, and extremely fissile, which slate is said to contain from 5 to 15% of manganese di-oxide. The statement was made to me by Mr. Perbas that this manganiferous slate is one of the most dependable indications of the existence of cupriferous pyrite orebodies in this district, and that he has observed it over large parts of the pyrite area in Huelva, and also in Portugal.

The Herrerias orebody is 98.5 ft. wide at a depth of 295 ft. from the surface. Above this it splits into two portions, one of which terminates abruptly at a depth of about 140 ft., while the other (the north branch) narrows upward, and then divides into three stringers, which develop slight enlargements at intervals. At the Rio Tinto the size of orebody is also variable, but is seldom narrower than 60 ft., and in the San Dionysio it attains a width of more than 200 feet.

Antonio Carbonell, in a private report, distinguishes between the various surficial indications of the Huelva pyritic orebodies, as follows: (1) Those which have been so completely eroded as to leave only a remnant of iron oxide, simulating a gossan or iron-hat. (2) Those in which a well-defined gossan has been formed directly in contact with the ore. (3) Those in which the iron-bearing solutions had penetrated through the slate above the orebody, giving indications of the existence of a deeply buried deposit. (4) Those in which no evidence is seen on the surface, and which have been discovered accidentally by excavations for other purposes, or by work done on the basis of purely geologic reasoning. He cites the orebodies in the Cabezas Rubias district as examples of the third class, and to this also pertain the Herrerias and Cabeza del Pasto farther west. Throughout the entire pyrite zone similar conditions are found, and, apart from

those that have been explored, the number of indicated deposits is enormous.

Inspection of the map of the province of Huelva will afford an impression of the wide distribution of these pyritic deposits through the zone of parallel basic intrusives. It will be seen that the Rio Tinto and the Peña del Hierro lie at the extreme eastern end of the belt in Huelva; that Tharsis is just west of the centre; and that a well developed area, from south to north across the zone, is found in the central portion. As Antonio Carbonell has pointed out, this development has followed, and has not preceded, the construction of railroad facilities. The recent developments at the Lagunazo, Herrerias, and Cabeza del Pasto, and the reported development of high-grade copper-bearing pyrite in the San Venancia mine, seven miles from the river Guadiana on the Portuguese frontier, led to the belief that the western area of the field may become highly important. It is also noteworthy that the northern edge of the ore-zone is still characterized by a line of thermal springs carrying iron in solution, and by one yielding sulphuretted waters.

The character of the ores throughout the zone is so similar that only an expert could distinguish between them, and it would often puzzle one to tell the difference between ore from the Tharsis and that from Rio Tinto. It is all pale yellowish-gray in color, with sometimes a greenish cast; it is lustrous on a fresh fracture, but dull on the fracture-planes. It breaks into sharply angular pieces, usually tending toward the form of a parallelepiped. It is never seen in crystal shapes, but would be described as a highly fissured massive one. It is not simple pyrite (FeS_2) but is an intimate mixture of the di- and mono-sulphide of iron ($x\text{FeS}_2 + y\text{FeS}$). In rare cases copper sulphide also enters into the mixture, and the ore then acquires a yellow color from chalcopyrite. This type is more abundant in the San Dionysio mine than in any other that I have seen, but I am told that the ores in the Cabezas Rubias district show the same characteristic, and considerable chalcopyrite is reported also from the San Venancia.

The copper for the most part follows the parting-planes in the pyritic masses, and consists of a coating of chalcocite, mostly of the sooty variety, and films of chalcopyrite. This physical occurrence may explain the facility with which the copper can be leached out. One constantly hears the opinion expressed that the copper is chiefly secondary and that the deeply buried deposits will prove lower in that element. This is a matter of vital importance for the future of the pyrite zone. Its ability to hold its own in the pyrite market of the world depends almost wholly upon the copper content of the ores.

The theory that the deeply buried masses of ore are low in copper would seem not to be borne out by the exploratory work done at Herrerias* and Cabeza del Pasto, where the ore was first found at depths of 140 to 200 ft.

*This does not imply that the copper content will not be low at profound depths.

below the surface and the copper content proved to be above 3%. At the San Venancia, on the other hand, the ore four metres of solid pyrite and ten metres of mixed pyrite contained only about 0.3% copper. At La Rica Ines, in the Cabezas Rubias district, where obscure indications were followed down to a body of rich pyrite, the copper content varied from 0.8 to 4% with an average of nearly 47% sulphur.

It is customary among the operators in the Huelva pyrite field to assume that the primary ore contained from 0.3 to 0.6% copper.⁴ The general average of 2% is attributed to secondary enrichment. At the Rio Tinto about three-fourths of the copper present is secondary, persisting to the lowest level of the San Dionysio (the 32nd, over 1200 ft. below the surface. The Rio Tinto yields the normal average of 2% from the bottom of the great open-cut, 590 ft. below the former surface, and 1150 ft. on the incline of the vein from the original outcrop. It is not uncommon to find zones, which possess a distinctly bluish-black hue from chalcocite, that are very much richer. Sometimes considerable quantities are mined that assay as high as 10 to 11% copper.

History of the Huelva District

By D. W. Brunton

The discovery of mineral in this district occurred at such an early period in this world's history that no trace of the date is now obtainable. History shows that the Phœnicians occupied the southern portion of Spain at least 240 years before the building of Solomon's temple, or 1240 B.C. The enormous amount of brass consumed in the building of the temple was undoubtedly made from copper mined in what is now known as the Huelva district.

The exact date of the Phœnician occupation cannot now be fixed, but the extent of their operations is attested by the numerous workings and the immense piles of slag. Unlike the Roman workings of later date, the Phœnician dumps and slag-piles never contained coin, and as coinage of money was invented about 700 B.C. it is evident that the Phœnicians must have been driven from the mines at or before that time, but by whom it is impossible to state. Not only is there sufficient evidence to show that the bronze for Solomon's temple was produced in this district, but it is evident that the miners of the district knew the destination of their product, as a round hill on the Rio Tinto river, a prominent mountain separating the north and south lodes of the Rio Tinto mine, and a village about four miles from the mines were all named after King Solomon. These names have not been given in recent times, for in the 'Rua Figueroa', written in 1557, the village in question is referred to as Zalamea la Vieja, or the Ancient Town of Solomon.

The Carthaginians invaded Spain in 237 B.C., and were in turn driven out by the Romans 32 years later. The date of Roman occupation can be fixed by the Roman coins found frequently in the slag-heaps, and in both surface and underground workings. These range through

the reigns of Augustus, Claudius, Nero, Vespasian, Trajan, the Antonines, Gallienus, Aurelian, Constantine, Grotian, Theodosius, down to Honorius. The remains of ancient villages with streets of dressed stone, pottery, and glassware are common on the surface, while in the old mine-workings are found picks, hammers, water-wheels, and ropes.

In the southern lode of the Rio Tinto in 1772 a copper plate, three feet by two feet by $\frac{3}{4}$ inch thick, was found fixed to the side of a drainage-level containing an inscription showing that it had been placed there during the reign of the Emperor Nerva, A.D. 97.

Roman operations at the mines must have terminated when the Vandals, Alans, and Suevi overran Spain A.D. 409, and after this for more than a thousand years no record exists that mentions the operation of these mines.

In 1556, Philip II delegated a priest named Delgado to examine the mines of Zalamea la Vieja. His report made on August 15 of that year, gives a pretty accurate description of the Rio Tinto mines.

About the middle of the 17th century a concession was granted to Alvaro Alonzo, allowing him to utilize the waters flowing from the mines in such a way "that iron placed in them may be converted into copper".

In June, 1725, Liebert Wolters, a Swede, obtained a lease for 30 years from the King of Spain and took possession of the Rio Tinto mines.

In 1742 an English woman named Mary Herbert obtained a warrant placing her in possession of the Rio Tinto for an indebtedness.

In 1746 the mines had passed into the possession of a nephew of Wolters named Tiquet, who obtained a lease for 30 years from that date, and it is believed that under his management the first active working of the pyritic ores recommenced after an idleness of nearly thirteen centuries. After the expiration of Tiquet's lease the mines were worked by the Government more or less irregularly until 1829, when the property was again leased to private operators.

In 1873 the mines were sold outright by the Government to the present Rio Tinto Company.

WHEN an explosion occurs in a large mine, with probable loss of life, an immediate start should be made toward the re-establishment of ventilation; assistance should be summoned from adjoining mining companies, from the State mine inspectors, and from the nearest U. S. Bureau of Mines car or safety station; and a working force with supplies and plans should be organized early. The saving of men after an explosion or mine-fire is the first consideration, and their location in the mine is of first importance. If men have come out of the mine after an explosion, there is a probability that other living men may be in adjoining workings. There is usually some one, an engineer, a superintendent, night foreman, or fire-boss, who has a good idea of where the men were working, even if the entire day shift is imprisoned in the mine. A well considered plan of action is better than hasty though well meaning effort.

Storage of Coal

*The spontaneous combustion of coal lies at the bottom of the subject of storage. Every engineer is familiar with the phenomena of self-heating of coal. For all that, the phenomenon is a relatively rare one. If we counted the times a portion of coal was stored where it would be undisturbed for a few weeks, the number of such storage operations in any one year would mount into the millions. Of these, a relatively small number show the phenomena of spontaneous combustion. There is no spontaneous combustion of anthracite coal, and very rarely does the domestic consumer of bituminous coal find troublesome heating. The main interest in the subject lies in the large piles needed for reserve for public-service utilities and the industries.

The heating of coal is believed to be a surface phenomena. If a ton of bituminous coal could be delivered in a single cube, each dimension would be about 2.8 ft. If the coal heats, it is due to something that goes on with respect to the surface and not something that happens inside of the piece. So far as we know, this is true no matter how small the piece is divided. If this cube, having originally about 47 sq. ft. area, is reduced to something about 16-mesh screen, there is an acre of exposed coal surface. It is perfectly obvious from this why it is that trouble from spontaneous combustion originates in fine coal, because the great increase in extent of surface does not begin until we get below $1\frac{1}{2}$ nut. If fine coal is kept out of the pile the heating surface is so relatively small as to remove the cause of spontaneous combustion.

A unit of area of this coal surface generates a certain amount of heat, provided it can find combining material. The amount of heat generated depends upon the temperature of the piece of coal. That is to say, coal put into storage at a temperature of 80° will generate very much more heat per unit of surface than if put into storage at the temperature of 60° . I cannot say just how much more, but the chemists tell us that in general the rate of chemical reactions doubles for every 10° rise in temperature, and if that applies in this case, 20° higher in temperature means a four-fold increase in the amount of heat generated. It has already been a matter of observation that coal stored during the hot months of summer and in heated areas is much more liable to spontaneous combustion than coal stored in colder climes and in cooler portions of the year.

Another most important factor is the freshness of the broken surface. A freshly broken surface of coal has a rate of heat generation that is a function of the kind of coal. It is practically zero with anthracite and is largest with the younger coals. The quantity of oxygen contained in the coal seems to be the fairest measure of this rate, although by no means reliable. The high oxygen coals of the Middle West and the sub-bituminous coals and lignites of the West show increasingly active rates of heating. The coal surface apparently becomes satis-

fied in time, and the heat produced falls to practically zero. This means that for the first few days or weeks a freshly broken surface is very much more active than after a few weeks or months. Fires rarely occur after surfaces have been exposed for three months.

Since the rate of heating increases with the temperature, it is evident that if the heat generated is not removed, the process becomes a self-aggravating one, in which case the rate of heat generation instead of falling may rise with time. If the temperature of the pile reaches 140° or 150° and continues to rise, there is a very considerable probability that, within a few days or a few weeks, a destructive temperature will be reached. If the temperature reaches 160° or 180° , there is almost a certainty that a destructive temperature will be reached and the coal must be moved. Immediately the question of getting rid of the heat is presented.

Suppose that coal was delivered in four uniform sizes and put in a conical pile by dropping at a single point. The granular arrangement of parts would be such as to furnish a foundation over nearly the whole pile, of larger sized pieces, and the lower flanks of the pile would be of the larger sizes. Nearly all of the smallest pieces would be in the central core of the pile. In the region of large pieces air would move freely and the coal surface exposed would be a minimum; hence there would be little likelihood of heating. In the centre of the pile the movement of air would be small, while the amount of heating surface would be great. If the fine coal is so densely packed as to prevent an exchange of air, there will be no heating because there will be no supply of oxygen to combine with the active surfaces. Somewhere between the two extremes of the central core of fine coal and the large-piece region, there may be areas where the ventilating current is just sufficient to supply oxygen for a maximum rise in temperature and insufficient to remove the heat as generated.

We know that if coal can be sealed tight, as in a glass jar, the oxygen soon disappears and the coal cannot continue to heat because of lack of oxygen. With no ventilation there will be no rise in temperature, and the zero point will represent the condition of coal sealed from the air or so densely packed that air cannot circulate. If, on the other hand, there is sufficient ventilation, the heat is all carried away as fast as generated. At some point between these two extremes there may be a condition of ventilation which will supply just oxygen enough to provide for a maximum rise in temperature. Since we have no means of knowing just what the ventilation is in any given portion of a pile, there is great hesitancy in advocating ventilating schemes for coal piles, as we are as likely to make trouble as to prevent it unless extreme and uniform ventilation is assured.

There are many more minor factors. One of the troubles has been that undue attention has often been given to minor factors, such as sulphur, height of pile, volatile matter, etc., while main factors, such as initial temperature, breakage in handling, freshness of coal and coal screening before storage, have been overlooked.

*Abstracted from an address by O. P. Hood of the U. S. Bureau of Mines.

The R & S Molybdenum Mine

The R & S molybdenum mine is situated in the western part of the Culebra range in Teras county, New Mexico. It lies about 27 miles from Jarosa, Colorado, on the San Luis Southern railway. The mine lies at an elevation of about 8700 ft. above the sea-level.

The yellow molybdic ochre that formed as an alteration product at the outcrop of the veins was long regarded as sulphur and gave the name to the gulch on which the mine is situated. About the time of the entry of the United States into the War it was realized that the black substance associated with the 'sulphur' was not 'graphite' but molybdenite, and the Western Molybdenum Co., of La Jara, Colorado, was organized to develop the prospect. No systematic development work was done by this company and no ore was produced. In November 1918 the R & S Molybdenum Co., of Denver, was formed and took over seven claims from the Western Molybdenum Co. and the new company has filed additional claims to increase the total holdings to about 300 acres. Development work was done throughout the winter, production began in the spring and was continuing at the time of our visit in the fall of 1919.

The buildings at the mine were an office, bunk-house, ore-sorting shed, and a blacksmith shop. The company has built a mile of good road to connect the mine with the main road on Red river. A remodeled gold-mill operated by water-power, situated five miles from the mine, is being used at the present time, involving a haul of ore by auto-truck. The equipment at the mill consists of a jaw-crusher, ball-mill, classifier, and flotation plant.

A tunnel has been driven for 300 ft. along one of the southernmost of the group of veins exposed on the property, and in places this has been stoped to a height of 60 ft. Only enough ore has been withdrawn to allow the work to proceed and considerable broken ore was still in the mine in September. The ore as it comes from the stopes is said to average about 2% MoS₂. This material is run over the grizzly and the fine goes directly to the ore-bins. The coarse material is hand-sorted and the tenor of the ore is raised to about 4%. Concentrate runs from 80 to 91% MoS₂ and no trouble is experienced in producing 90% concentrate. The concentrate is said to be low in copper and phosphorus.

The rocks of the region are a soda-potash alaskite porphyry in which the ore occurs, a dark gray granodiorite porphyry, and volcanic tuffs and flows.

The alaskite has been sheeted for about a thousand feet in a north-south direction along Sulphur gulch and this sheeting is said to extend for several thousand feet in an east-west direction. There are a number of main fractures which are approximately parallel and strike about N. 79° W. The veins are all the result of mineralization along these fracture and shear-zones. The larger ones follow the main shear-zones, but smaller veins and flats branch, intersect, and re-unite forming a complex net-

work. Yellow molybdic ochre makes the outcrop of the veins conspicuous and easily traced. Development work has been confined almost entirely to one vein near the southern border of the group, but its surface indications were no more promising than those of several other veins. In the 300-ft. adit the mineralized zone has been rather constant in its characteristics, varying in width from 4 to 6 ft. The ore-zone is shattered and sheeted alaskite with the ore filling the fracture. Small veins and films of ore penetrate the wall-rock, but there is almost no replacement of the alaskite and so very little molybdenite is found disseminated in it.

The mineralized zone which is being stoped contains a comparatively small proportion of vein-filling, as sericitized alaskite lies between the small branching veins. This vein-filling is made up mostly of quartz with a large proportion of molybdenite, some pyrite, a little chalcopyrite, fluorite, sericite, apatite, biotite, chlorite, and calcite. The relationships show that the alaskite was thoroughly sheeted before the introduction of the vein minerals, but that minor movements continued up to the time of the deposition of calcite, the last mineral to form.

Molybdenite is generally regarded as a primary mineral deposited by magmatic waters, but it has been described from deposits that have been formed at vastly different depths and at very different temperatures. In the R & S mine its association with pyrite, fluorite, sericite, biotite, and quartz in a mineralized shear-zone indicates that the ore has been formed by ascending magmatic waters, probably at a moderate temperature.

As yet molybdenum ore has been found in only a comparatively small area in Sulphur gulch. The veins are in a zone of shearing in an alaskite and there appears to be a number of veins that promise to be of sufficient width for economical mining, and many smaller stringers. The veins are of a kind that not uncommonly lack persistence and it is not safe to assume a continuation of the ore-bodies much beyond the developed areas. However, the 300-ft. adit exposes several thousand tons of ore.

THE Bureau of the Mint, with the co-operation of the U. S. Geological Survey, has issued the following statement of the preliminary compilation of the production of gold and silver in the United States during the calendar year 1920. Compared with the production in 1919 these figures indicate a decrease in the gold output of \$10,824,-000 and in the silver output of 117,941 ounces.

State	Gold, oz.	Value	Silver, oz.	Value
Alaska	380,034	\$7,856,000	792,751	\$804,745
Arizona	239,118	4,943,000	6,098,251	6,190,518
California	692,019	14,305,300	1,513,495	1,539,394
Colorado	368,298	7,613,400	5,572,407	5,656,718
Idaho	22,509	465,300	7,531,253	7,645,201
Michigan .....	.....	.....	510,601	518,329
Missouri	19	400	123,219	125,083
Montana	88,971	1,839,200	13,583,164	13,788,677
Nevada	171,968	3,554,900	7,392,689	7,504,540
New Mexico	22,417	463,400	764,586	776,154
Oregon	46,087	965,100	182,558	185,320
South Dakota	203,243	4,201,400	84,351	85,627
Tennessee	280	5,800	112,505	114,299
Texas	5	100	524,212	532,143
Utah	100,446	2,076,400	11,564,155	11,739,121
Washington	7,198	148,800	183,437	186,213
Philippines	51,568	1,066,000	21,917	22,240

*Abstract of an article by E. S. Larsen and C. S. Ross, of the U. S. G. S.

REVIEW OF MINING

FROM OUR OWN CORRESPONDENTS IN THE FIELD

ARIZONA

UNITED EASTERN DECLARES DIVIDEND.

KINGMAN.—The Dardenelles mine has shipped its seventh carload of ore. Shipments are yielding approximately \$1200 net per car. This ore production is coming from the 160-ft. level. The Dardenelles mine is situated in the Chloride district near the old Elkhart mine.

Judge Bollinger has handed down a decision favoring the plaintiff in the matter of the shareholders of the Midway Mining & Milling Co. v. the Midway Moss Mining Co. This decision voids the action of the directors of the old company in transferring the title of the property to the new organization, the Midway Moss Mining Co., and compels the re-transfer of the holdings and the dissolution of the new company.

Frank A. Garbutt has petitioned the Superior Court for a new trial in the cause of Frank A. Garbutt against the Schuylkill Mining Co. and C. A. Burke in which a receiver was appointed by Judge Crosby for the Schuylkill Mining Co. The cause of the original litigation grew out of the various loans made by Mr. Garbutt to the Schuylkill Mining Co. aggregating \$300,000. The company secured Mr. Garbutt by a mortgage on the property. Mr. Garbutt sought to foreclose this mortgage. The defendants raised the issues that they were prepared to finance the company and the judgment gave them time to come in, build a mill, and develop the mine under a receivership, while at the same time the interests of Mr. Garbutt were to be conserved. The mines at issue are the Tennessee and Schuylkill at Chloride. It is alleged that the Tennessee has about 30,000 tons of good ore opened with the possibility of opening 70,000 tons or more with further work.

OATMAN.—The drift on the 400-ft. level of the Telluride mine is reported to have opened ore that averages \$30 per ton in gold. This ore-shoot, which was first opened on the 500-ft. level, assayed \$40 per ton. The property of the Telluride company corners on the Tom Reed and the United American properties.

The United Eastern Mining Co.'s directors at a recent meeting held in Los Angeles declared the regular quarterly dividend of 15c. per share payable January 28 to stock of record January 8. The company paid 72c. per share in 1920. The total dividends to date have been \$3,339,350. It is reported that the cash reserves of the company are in excess of \$900,000. Approximately 102,000 tons of ore was treated in 1920 which assayed better than \$21 per ton.

COLORADO

MINING AT CRIPPLE CREEK IS ACTIVE.

ASPEN.—The recent discovery in the Jenny Lind tunnel by the Park Tunnel Mining Co. has brought about renewed activity in the Tourtelotte Park section. Lessees have filed applications for leases on properties traversed by the tunnel, now controlled by the Tunnel company. The Jenny Lind find on Sam Houston ground is reported holding up in value and in strength of the vein.

CRIPPLE CREEK.—A surplus of labor, the first in four years, is reported at the mines, where notices 'No Miners Wanted' are posted. Wages have been cut 50c. per day, affecting all employees. The second diamond-drill test in the east end of the district is reported progressing with depth attained of beyond 800 ft. Two phonolite dikes with some mineralization have been passed through and the drill is nearing the Bolivia Dike junction, the objective point. Shipments continue steadily from the Portland, Cresson, Vindicator, Modoe, and Granite companies' properties, from operations on company account; and, in addition, renewed activity among lessees is reported.

RICO.—Operations are to be resumed at the Emma mine at Dunton, owned by A. E. Reynolds of Denver. A contact has been proved between the fifth and sixth levels and a raise is to be carried up from the sixth to prospect this contact, believed to carry high-grade ore. The shaft is now being unwatered by a force in charge of J. Clamp, mine superintendent. Ore running high in silver has been struck on the J. W. Burns property on the west side of the river at Burns near Rice. Water is causing trouble and a Cameron sinker will be brought up and placed in the winze where the discovery was made. The property is operated by lessees. Ore of shipping grade is being saved for shipment on the Badger group of claims in Allyn gulch, operated by Hay Brothers of Rico.

MICHIGAN

COAL-PULVERIZING PLANT FOR MICHIGAN SMELTER.

HOUGHTON.—No copper is being shipped out of the district. Metal is accumulating at all smelters. Mohawk and Wolverine are the only mines that have small metal stocks. Calumet & Hecla, Copper Range, and Quincy have been unable to make any reduction of their surpluses. Calumet & Hecla, which formerly had a market for oxide copper, is shipping none of that now. The

greater portion of it, which comes from the leaching-plant is being smelted. Fourteen furnaces are still in commission at the smelters, eight being closed. Two of the fourteen in use are of the large type, of 1,000,000 lb. monthly capacity. Twelve are of the smaller type, each having a capacity of 40,000 to 50,000 lb. per charge. None of the furnaces is being pushed to capacity.

Calumet & Hecla sold \$300,000 worth of silver in 1919, but the annual report for 1920 operations will show the income from silver considerably reduced. Silver dropped in price during 1920 and less of it was sold by the company. None has been shipped in recent weeks. The production of silver also will show a falling off during the period of curtailed operations.

Equipment has been ordered for the new coal-pulverizing plant at the Michigan smelter, as an auxiliary for coal-dust burners at the furnaces. It is expected the plant will go into operation in the spring. Coal now is fed into the furnaces automatically as it comes from the coal pits. When the pulverizing plant is in use the coal will be ground and sprayed into the furnace as fuel-oil would be sprayed. The entire operation will be automatic, the pulverized coal being forced through pipes and into the furnaces by air pressure. The method will be new in the Copper region.

Franklin, which has been shut-down since June 1 last, but which has been keeping its shafts free of water, is now preparing to cease even pumping operations. The pumps and other underground equipment that can be moved will be brought to surface and the shafts permitted to fill with water. The water from No. 2 flows into No. 1 and all pumping has been centred in No. 1. The fires will be drawn in the boilers in a few days and the property closed entirely for an indefinite period. Franklin stopped production in May 1919, but from that time until the first of June 1920 it did considerable development work. It was during the course of these development operations that well mineralized ground was entered on the 39th or bottom level. The shaft was sunk from the 37th to the 39th and it is the belief that the rich streak in the 39th extends upward for ten levels. If subsequent developments prove this to be true, it will give the company a large tract of good ground.

NEVADA

CONSOLIDATED VIRGINIA COMPANY TO BE REORGANIZED.

ELY.—R. C. Gemmell, general manager for the Utah Copper company and assistant managing director of the Nevada Consolidated, and D. D. Moffat, consulting engineer for the Jackling interests, recently inspected the Nevada Consolidated mines and reduction plant and then left for San Francisco, where they were to confer with D. C. Jackling regarding plans for the future for the Utah Copper, Nevada Consolidated, and Nevada Northern railroad.

VIRGINIA CITY.—The United Comstock is employing 125 men at Gold Hill and when work is started on the tunnel from the Knickerbocker, Jacket, Belcher, and Imperial shafts, in addition to that now being done from

the portal, this force will be increased greatly. The tunnel is being driven at a rate of 300 ft. per month. The Consolidated Virginia is to be reorganized, according to action taken at the recent annual meeting of the company in San Francisco. The capital stock is to be increased from 216,000 to 2,160,000 shares of a par value of \$1 each and the exchange is to be 10 for 1. The annual report of Axel Wise, superintendent, shows that the company mined last year 17,706 tons of ore of a gross value of \$353,960 and a net value of \$259,686. A total of 3275 ft. of development work was done. The superintendent says: "The east vein is a pre-mineral vein and at its intersection with the Comstock lode it formed a large and rich bonanza. The east vein was and is rich and productive, but it does not carry the enormous tonnage that the Comstock ledge does. In mining the Comstock lode and the east vein, selective mining was carried on and the fills of low-grade material were left. The present scheme is to put the mine in shape to handle this low-grade material at a small cost. This can be done by perfecting the haulage-ways and blocking out large sections of the fills in such manner that they can be worked on a large scale and at low cost. By judiciously mixing lower-level ore with the large tonnage of upper-level ore we can keep the Mexican mill running to capacity for an indefinite time. Our aim is to mine and mill 4500 tons every month in the Mexican mill at a cost of \$27,000 per month, with a mining and milling cost of \$6 per ton."

MINA.—The 150-ton flotation plant of the Simon Silver-Lead is said to be half finished. It is announced that the company, instead of getting power from semi-Diesel engines, will obtain electric power over a line from Millers, the construction of which would cost \$60,000.

ARROWHEAD.—Ore five feet wide, with one to two feet assaying as high as \$1000 per ton in silver and gold and the remaining three to four feet assaying \$30 to \$40, has been opened in the 50-ft. west drift on the third, or 267-ft., level of the Arrowhead. The 45-ft. east drift on this level also is in the ore-shoot opened on the upper levels, proving it to a depth of 300 ft. on the dip of the vein. The shaft is 320 ft. deep and it is 20 or 30 ft. below water-level. New equipment consisting of a 25-hp. hoist and a steel head-frame is now in use. Air-drills are not used, because drilling by hand has been found more economical and equally as efficient.

DIVIDE.—The shaft of the re-organized Belcher is to be sunk from the 350-ft. level to the 500 or 550-ft. point, according to N. M. McCormick, manager. Recent work has been confined to the 350-ft. level, where seams of low-grade ore have been found. A cross-cut from the south-east drift on the 800-ft. level of the Tonopah Divide has proved that the rich ore recently opened at that depth is only slightly wider than the drift. Cross-cuts are being driven on the 1000-ft. level in prospecting for the extension of the shoot on the 800-ft. level. A drift being driven toward the Brougher on the first level has been in \$30 ore for 65 feet.

WEST DIVIDE.—Edward Bevis, of Tonopah, has succeeded L. L. Patrick as manager of the West Divide, and

John Bricker has succeeded George Pearson as superintendent. Bertha Garnett of Goldfield has resigned as secretary and the affairs of the company are now handled in the office of Allan Rives at Tonopah. Heretofore the company has been operated partly from Goldfield and partly from Tonopah and the change is said to be for the purpose of securing more economical operation by making Tonopah the headquarters.

UTAH

PLAN TO SHIP BULLION TO NEW YORK BY WAY OF SAN FRANCISCO AND THE PANAMA CANAL IS DELAYED.

SALT LAKE CITY.—During 1920, the number of fatal accidents in the metal mines of the State totaled 20. In addition, six miners lost their lives in snow-slides at Alta; but these accidents cannot be charged to mining operations. During 1919, the total number of deaths was 15, the lowest in years. During 1920, fewer men were killed by falling rock, but there was a large increase in the number killed by explosives. The Industrial Commission reports that 30% of the accidents in 1920 could have been avoided by the companies; 40% of the total was due to carelessness of fellow employees; 10% to carelessness of victims; while the remaining 20% was purely accidental. In the smelters of the State, three men were killed, as compared with four in 1919; while in concentrating plants, three were killed, as compared with one in 1919. The annual meeting of the Utah Chapter of the American Association of Engineers was held on January 11. Officers elected for the following year are C. C. Burt, president; T. S. Bult, vice-president; W. H. Carriek, secretary; J. Blickensderfer, C. S. Fisher, and C. J. Rich, directors. The Chapter will make an effort to secure the 1922 convention of the national association for its city.

The plan of local smelting companies to ship bullion to San Francisco and then by boat to the Atlantic seaboard, has been temporarily halted, owing to the order of the Interstate Commerce Commission suspending the rate of \$6.50 per ton on smelter products from this city to San Francisco. At the present time, the rate of blister copper from the Garfield smelter to the Baltimore refinery is \$22 per ton and to the Perth Amboy refinery \$21.40 per ton. It had been planned to ship the blister copper by way of San Francisco and the Panama Canal, and the total transportation charge, including insurance, handling, etc., would be between \$15 and \$16 per ton, effecting a saving of \$6 to \$7 per ton in freight charges. A ruling on the question to determine whether the \$6.50 rate, or a higher rate, should apply will take place in this city on February 16. At the present time, the Garfield smelter is shipping a small quantity of its blister copper to the Tacoma refinery.

PARK CITY.—Arguments under the writ of certiorari granted the Silver King Coalition Mines Co. on its appeal from the judgment in favor of the Conkling Mining Co. for approximately \$500,000, are being heard by the United States Supreme Court. The case has been one of

the most bitterly contested mining litigations in the West. The Conkling company sued the Coalition for the wrongful extraction of ore from the Conkling claim, owned jointly by the two companies. The Coalition company set up the claim of extra-lateral rights in defence and prior ownership of part of the property in dispute. In the United States District Court for Utah, Judge J. A. Marshall on July 15, 1912, decided in favor of the Coalition company on both defences. The Conkling company appealed to the Eighth Circuit Court of Appeals, where the decision of Judge Marshall was reversed on February 12, 1916, and judgment entered in favor of the Conkling company for \$383,000. The Coalition company then appealed to the United States Supreme Court. Since the



HYDRAULICKING NEAR ATLIN, B. C.

commencement of the suit, some of the most prominent people with both companies have died. David Keith, president, and Thomas Kearns, vice-president and general manager of the Coalition; Judge Curtis H. Lindley, one of the attorneys for the Coalition; Nicholas Treweek, president of the Conkling company, and E. B. Critchlow, counsel for the same company, have died.

EUREKA.—Ore shipments from this district for the first week of the new year totaled 181 cars, of which the Tintie Standard shipped 61; Chief Consolidated, 32; Dragon, 23; Iron Blossom, 15; Eagle & Blue Bell, 13; Iron King, 10; Victoria, 9; Colorado, 4; Swansea, 4; Mammoth, 3; Bullion Beck, 2; Centennial-Eureka, 2; Gold Chain, 1; Sunbeam, 1; Gemini, 1.

BRITISH COLUMBIA

CANADIAN PACIFIC COMPANY ESTABLISHES FREIGHT-RATES BASED ON THE VALUE OF THE ORE.

PRINCE RUPERT.—H. S. Munroe, general manager for the Granby Consolidated M. S. & P. Co., passed through here on his way to New York. He denied emphatically that any negotiations were pending between either the C. P. R. or the Consolidated M. & S. Co. for the purchase of the Granby company's holdings in British Columbia,

and he further denied that any of the Trail engineers had made an examination of the Anyox properties. Mr. Moore said a satisfactory wage adjustment had been made, that the plant was working smoothly and turning out more copper than it had done for some time. The Premier mine has started to ship ore to tide-water; two Holt tractors are being used over part of the distance. The Bellevue group, on the Illianee river, is developing well. A 40-ft. lode has been traced for nearly a mile, and samples of the openings are said to average 23 oz. in silver and \$1.40 in gold and 3.5% lead. Development work is to be continued throughout the winter, and if the price of silver is satisfactory it is proposed to erect a concentrating plant next summer.

It appears that the closing of the Dolly Varden mine was not due to labor trouble, as was at first thought, but that the owners considered that indications pointed to cost of labor being cheaper in the spring, and, as there is no possibility of shipping during the winter, it would be more economical to close the mine. Last spring, when labor had the whip hand, it drove a hard bargain with the Taylor company, and it looks rather as though the present move was in the nature of retaliation. Anyhow, it will not tend toward a better understanding of capital and labor in the district.

NELSON.—Several of the mines in the Sloean, including the Silversmith and the Whitewater, have been shipping recently to the United States S. & R. Co.'s smelter, at Midvale, where, it is claimed, a better rate is obtainable than at Trail. This traffic, however, has received an abrupt check by a change in the C. P. R. freight-rates which went into effect on December 23. Shippers had been in the habit of declaring the value of their consignments at the minimum, namely \$50 per ton; the understanding being that in the event of loss in transit the railway company was responsible only for the declared value. By the new schedule the freight-rate is to be based on the actual value of the ore, as shown by the smelter return, and, as little ore worth less than \$150 per ton is sent out of the Sloean, the new rate will mean an increase of more than 50% to the shippers. The bulk of the ore cannot stand this new rate, and shippers are looking upon it as practically amounting to a mandate on the part of the C. P. R. that all ore must be smelted at Trail. This coming at a time when Trail is offering only warehouse receipts, redeemable when the metal is marketed, for ores received is causing much bitter feeling among the operators of the small mines.

ONTARIO

NIPISSING PAYS \$600,000 IN DIVIDENDS.

COBALT.—As the result of power shortage, coupled with the low price of silver, only about ten of the silver mines are now being operated out of 19 which were working during the summer, and most of these are producing on a much reduced scale. Ore shipments last week were light, amounting to only 162,484 lb.; no bullion was sent forward. The number of men at work in the camp is

estimated at about 1000, as compared with 2000 employed during the summer. While it is believed that the present supply of power can be continued until well on in February, the situation is uncertain, being dependent upon the weather. The Nipissing is the only company which has not considerably curtailed its operations during recent months.

On February 15 wages to the employees of the mining companies of the Cobalt district will be reduced 75c. per day or approximately 15%. A statement by the Temiskaming Mine Managers Association sets forth that owing to the price of silver being half what it was a year ago about 18 properties had been compelled to close down entirely or suspend operations, while those companies still maintaining their output have reduced their working forces. The Nipissing disbursed a dividend and bonus aggregating 10%, amounting to \$600,000, on January 20.

The surface veins found on the Kerr Lake prove disappointing with underground work. A raise on one of them to within 30 ft. of the surface has not disclosed any silver content and enrichment appears only to extend downward for a few feet. The Kerr Lake is negotiating with the Hargraves Consolidated with a view to obtaining a working option on two properties adjacent to it own.

The La Rose is obtaining a good grade of ore from its University and Princess properties—work on the original La Rose being practically confined to the powder-house vein from which several thousand tons of broken ore in stopes are being hoisted.

KIRKLAND LAKE.—This camp has benefited by the slackening of operations at Cobalt, as many of the skilled men recently employed at the silver mines have been taken on at Kirkland Lake. The Ontario-Kirkland announces that it has over two years supply of ore for the mill in sight. The shaft has been sunk to a depth of 475 ft. with levels at 100, 300, and 450 ft. and over 2500 ft. of lateral work has been done on the two lower levels opening up a large body of good milling ore assaying from \$8 to \$28 per ton. The company will bring in supplies and machinery during the winter and push construction work on the mill in the spring.

A shipment of gold bullion valued approximately \$30,000, the output during the month of December has been made from the Kirkland Lake mine.

At the Lake Shore the shaft has reached the 600-level and sinking has been stopped until a level is established and cross-cuts run to tap No. 1 and No. 2 veins. The latter, which underlies Kirkland Lake, is a highly important orebody.

PORCUPINE.—It is anticipated that the Dome Mine will be able to treat an average of about 500 tons of ore daily on its present power supply throughout the winter. It is understood that the present dividend rate of 2½% quarterly will be maintained regardless of the temporary reduction of output, as it is expected that as soon as adequate supplies of power are available the volume of ore handled will be greater than ever before.

THE MINING SUMMARY

COPPER PRODUCTION

The 'porphyry' copper companies as a group produced more copper in 1920 than in 1919, seven companies listed below turning out approximately 422,137,367 lb. last year, against 407,328,114 lb. in 1919, an increase of 14,809,253 lb., or 3.6%. This estimate is based on monthly reports and may later be revised slightly. The actual production of this group of companies in 1918 was 627,832,011 lb., so that last year's output showed a drop of 205,694,644 lb., or 33%.

Utah Copper was the only one of the group that did not turn out more copper in 1920 than in 1919, the decrease being approximately 2,500,000 lb. Utah's production last year was the smallest since 1912, when it amounted to 91,663,377 lb. The record output was 195,837,111 lb. in 1917. Nevada Consolidated's 1920 output gained about 4,328,000 lb. over 1919, but it was 28,308,000 lb., or 24%, under that of 1918. Nevada's record production was 90,735,000 lb. in 1916.

Miami and New Cornelia showed the least curtailment as compared with 1918. The 45,705,000 lb. turned out by the former last year was 30,930,000 lb. under that for 1918. His company's record production was 79,636,000 lb. in 1917.

The following compares the copper production by seven prominent porphyry companies during each of the past three years, the figures being in pounds:

	1920	1919	1918
Arizona	45,705,490	40,488,706	76,635,641
Inspiration ...	81,250,000	78,036,306	98,540,041
Miami	55,092,288	54,221,638	58,407,563
Nevada	48,299,256	43,871,892	76,607,062
New Cornelia..	40,818,456	39,509,461	46,950,139
Ray	48,397,935	46,011,371	83,599,160
Utah	102,573,942	105,088,740	188,092,405
Total	422,137,367	407,328,144	627,832,011

DECISION IN SUIT OF RICO CONSOLIDATED V. RICO ARGENTINE

Decision in the apex suit of the Rico Consolidated Mining Co. v. the Rico Argentine Mining Co. for the recovery of ore alleged to have been taken out of the plaintiff's territory has been made in favor of the plaintiff by Judge W. S. Searcy of the Sixth Judicial District Court of Colorado. In his decision Judge Searcy holds that trespass was not willful, but made in good faith. Consequently damages awarded amount to \$29,946.50 against the Rico Argentine company and \$346.50 against the Marmatite Mining & Milling Co., lessee of the defendant. The judgment of approximately \$37,000 represents the net mine value of nearly 5000 tons of ore extracted by the defendant. Mining men of the district agree that the valuation of the ore contested for in the litigation is small in comparison with the bodies that can be mined by the Rico Consolidated Mining Co. in the light of this new decision. Judge Searcy's decision that the ore-beds, for possession of which the Rico Consolidated Mining Co. instituted suit, were formed by east-west fissures rather than by the Blackhawk fissure reverses theories held among mining men in the past concerning the mineralogy and geology of the

district. As a result of this decision, it is said, claims held by other companies will be affected. Fred Price, president and general manager of the Rico Argentine Mining Co., made the following statement:

"Our counsel contended that the Blackhawk fissure was the source of the enrichment of the beds which we followed into the conflict area. The plaintiff held that the Allegheny and its parallel east-west fissures were the source and apex of the ore-beds. According to our conception of the geology of the district, the Blackhawk is the master fissure. This vein, standing nearly vertical, traverses the country for miles and cuts upon our property a formation which consists of alternate strata of soluble and insoluble lime and sandstone.

"All of the six veins mined upon our property are replacement orebodies in beds of soluble limestone. We hold that these beds were enriched by solutions which proceeded from the Blackhawk fissure that apexes on our ground.

"Two of the fissures, No. 2 and No. 6, have been followed to the Blackhawk fissure, where they merge. At the juncture of No. 6 vein with the Blackhawk ore was stoped out for 100 ft. above the level and into the master fissure. From this one stope Tom Walsh, pioneer mining man of Colorado, took out enough ore to pay for the Camp Bird, the exploitation of which made him the wealthiest operator in Colorado.

"Four of the veins followed into the conflict area outcropped in our territory. As the ore in these beds led into the Rico Consolidated ground over the side-lines, we followed it."

CHILE COPPER COMPANY WILL BUILD REFINERY

Unofficial announcement is made that the Chile Copper Co. is to construct a refining plant at its properties in South America. The Chile company is the lowest-cost producing property in the world. In the third quarter of last year the cost of copper was only 11.179c. per pound, including the selling and delivery expense. The construction of a refinery at the properties would permit a material reduction in this cost, as it would mean that the company could deliver the refined product in this country. The company has the advantage of the low cost of labor—only \$1.25 per day, as well as cheap water-power. Even at the present low price for copper Chile is one of the few companies that can make a profit. During the third quarter of the past year, when practically all the large properties in this country were operating at a loss, the Chile company reported net profit on copper delivered of \$2,105,160, while after all expenses, depreciation, and interest charges were deducted there was a surplus for the third quarter of \$878,008.

AMERICAN ZINC, LEAD & SMELTING CO.

The American Zinc, Lead & Smelting Co. enters the new year with net quick assets of between \$3,500,000 and \$4,000,000, with ore stocks at a minimum and with inventories marked down to the lowest prices. Operations are also down to a minimum and at present it is hard to earn operating expenses. In the first half of last year net earnings amounted to \$344,975; from July on, however, the market for zinc and for all non-ferrous metals, for that mat-

ter steadily declined, so that the 1920 report will show an operating loss. The physical holdings of American Zinc Co. are today in the best shape in their history. Ore in the Mascot mine is developed for ten years ahead.

RESEARCH GRADUATE ASSISTANTSHIPS

The Engineering Experiment Station of the University of Illinois announces 16 research graduate assistantships for each of which there is an annual stipend of \$600 and freedom from all laboratory fees. Graduates of approved American and foreign universities are eligible for these appointments. Nominations are based upon character, scholastic attainments, and promise of success in the research to which the candidate proposes to devote himself. Some practical engineering experience following graduation is desirable. Additional information may be obtained by addressing the director at Urbana, Illinois.

ARIZONA

Kingman.—F. P. Aylwin and associates have taken over the Dean mine, situated 14 miles from Kingman in the Wallapai mountains. Shipping-ore is being extracted pending the completion of the 75-ton flotation plant. Silver is the chief product, with some lead and zinc. The staff includes Lyman F. Barber, metallurgist, W. B. Dunlap, mine superintendent, Robert Blum, engineer. A new road to the mill is now completed and nearly all machinery is on the ground.

Oatman.—The United Eastern and Tom Reed mines are working close to capacity, general conditions at the two producing mines being favorable. There are plenty of skilled men which tends toward a higher efficiency. The output of both mines for January is expected to be higher than that of December.—The United American is sinking the winze from the lower level at the junction of the vein and the cross-cut.—The Telluride is working a double shift on the fourth and fifth levels. Good ore has been found and drifting is progressing.—The Amalgamated is working one shift cross-cutting on the 600-ft. level, and it is expected to cut the vein about 70 ft. farther ahead.—The Argo is cross-cutting north on the 600-ft. level; so far there is nothing of interest to report in new developments.—The Oatman United is working one shift following a good lead east in hope of picking up the main vein at this depth.

Pima County.—An important development in the mine of the El Tiro Leasing Co. is the opening of an ore-shoot on the 300-ft., or bottom, level. The orebody averages 5% copper and is said to double the ascertained value of the property.

CALIFORNIA

Amador County.—According to Edwin Higgins, manager for the Metals Exploration Co., it will require five months to place the Fremont mine in operating condition. The mine has been unwatered and the 40-stamp mill is being overhauled in preparation for production.—The 40-stamp mill at the Bunker Hill mine near Amador City has resumed operations at maximum capacity. Production was curtailed during the greater part of 1920.

Calaveras County.—J. A. Vigeant is negotiating for control of the Nassau copper mine near Angels Camp. Besides copper, the ore contains some silver and gold.

Nevada County.—The North Star Mines Co. has declared a dividend of three cents per share. This is the first distribution since January 1918. To date \$5,587,000 has been distributed among the stockholders.—Eighty stamps in the Empire mill are in operation. More ore is being mined than at any time since the outbreak of the War.—The Western Precious Metals Co., according to W. A. Simpkins, general manager, will commence the development of a series

of gold veins on the Mitchell ranch east of Grass Valley. No work other than surface trenching has heretofore been undertaken on these claims.

San Francisco.—The annual election of officers for the San Francisco section of the American Institute of Mining and Metallurgical Engineers was held Tuesday evening, January 11. The officers are as follows: Frank L. Sizer, chairman; Edwin Higgins, vice-chairman; C. H. Fry, secretary and treasurer; and James M. Hyde and Lester C. Uren, members of the executive committee. Max Thelen addressed the Section, his subject being 'Impressions of Washington'. Fletcher Hamilton discussed the gold problem and the McFadden bill from the standpoint of the gold producer in California. A number of members expressed their dissatisfaction with the action of the directors of the Institute in New York in levying a 'voluntary assessment' to meet the financial deficit existing at the end of the year. A resolution was finally prepared and unanimously adopted, requesting of the directors further information as to the reasons for the deficit and urging that an investigation of the Institute's publications be made.

Ubehebe.—A carload of lead-silver ore, which is expected to net \$60 per ton, has been shipped from the Arrowhead-Rice property. The ore contains 60% lead and 34 oz. silver per ton. Two carloads of ore are being sacked, but work will be discontinued until a tunnel, which is expected to cut the vein at a depth of 300 ft., has been completed. Three samples, averaging 70% lead, from a width of 8 ft., were obtained from a second vein that is parallel to the first.

COLORADO

Denver.—Thirty-days notices of wage-reductions of 50c per day were filed with the State Industrial Commission by three mining companies late Monday. The Wasatch-Colorado Mining Co., of Silver Plume, notified the Commission that "present mining and market conditions force us to take this step to keep from closing the mine and mill". The step referred to was the company's notice of a wage-cut of 50c per day, beginning February 14. The Hollingsworth Main Co., of Silver Plume, also gave notice of a similar wage reduction. Tomboy Gold Mines Co., Ltd., of Telluride, through N. S. Kelsey, general manager, gave the Commission notice of a 50c. cut in wages on February 15.

Telluride.—Ore and concentrate shipments from the Telluride station for December were: Smuggler-Union, 59 cars of concentrate; Tomboy, 48; and the Liberty Bell, 19; total 126 cars. The Belmont-Wagner Mining Co. has engaged John M. Wagner, former manager of the Alta mines, to extend the adit, which was started some months ago, on into the vein. The tunnel is 7 by 7 ft. It will serve the double purpose of securing more ventilation and getting the ore to the mill more easily and cheaply than tramping it. Wagner will select his crew and start work immediately.

IDAHO

Bonnets Ferry.—A 4200-ft. Riblet wire-rope tramway was recently purchased by the Cyanide Gold Mining Co., operating the Buckhorn property, 22 miles north-east of here. This is to be shipped at once to Eileen, 13 miles from the mine and will be installed and ready for use in three or four months. A 50-ton ball-mill has been installed, with provision made for an additional unit of 50 tons. With the tramway in operation the present mill capacity will be 1 tons per day.

Coeur d'Alene.—Work on the new concentrator for the Sunshine Mining Co., operating the Yankee Boy mine at Big creek, is progressing, a large portion of the material for the building now being on the ground. The mill will start with a daily capacity of 50 tons.—The Lookout Mountain Mining Co. has installed a 10 by 10-in. Sullivan compressor on its property in the Pine Creek district and now has

ordered a gasoline engine to supply power. As soon as this is installed contracts will be let to carry forward the work on the No. 2 tunnel, which should reach the vein at a depth of 300 ft. The management expects to cut the vein with an advance of 150 ft.—A dividend of 4 cents per share, amounting to \$75,091, has been declared by the Tamarack & Custer mine, payable on January 16. It is the first dividend the company has paid for more than a year. The company is capitalized for 2,000,000 shares, but only 1,877,288 shares have been issued. It is said, however, that cash on hand is only about \$200,000; also that the company has \$1,000,000 worth of bullion on hand, either at the smelter at Northport or the refinery in Pennsylvania. The Tamarack & Custer owns a half-interest in the Northport smelter and the refinery in Pennsylvania.—The Caledonia Mining Co. paid its usual quarterly dividend on January 5. Work of exploration will continue at the property, but not much money can be made at present prices of lead. The earnings of the last quarter may be close to the amount of the quarterly dividend, which is one cent per share, or \$26,050.—Machinery and equipment for the Jim Blaine Silver Syndicate, operating the Jim Blaine-Bristol groups on Pine creek, has been de-

ing results thus far.—The East Butte company believes that the deficit from present operations will be small as compared with the net losses that would result from entirely shutting-down the mine and smelter and accordingly does not propose to curtail operations further. The force has been cut to the minimum but the best men are being retained. Underground ore-sorting is being done with the result that the grade of ore hoisted is averaging more than 5% copper. The production for 1920 amounted to 8,300,000 lb. of copper.

The Great Northern Railway has made an electrical survey of its line between Butte and Great Falls, with a view to replacing steam-locomotives with those run by electricity. The construction of a power-plant at Lake Chelan, Washington, at an estimated expenditure of \$1,500,000, is the first step toward the electrification of the company's lines in Washington.

Cooke City.—William Nichols and Oscar Miller have optioned four claims to the Irma Mining Co. for \$10,000. All of the larger mines in the district are continuing their work through the winter months.

Great Falls.—A 25-ton furnace for the manufacture of brass has been installed by the Anaconda Copper company at the Reduction Works. This is an experimental unit in which the technique of producing brass on a large scale will be perfected.

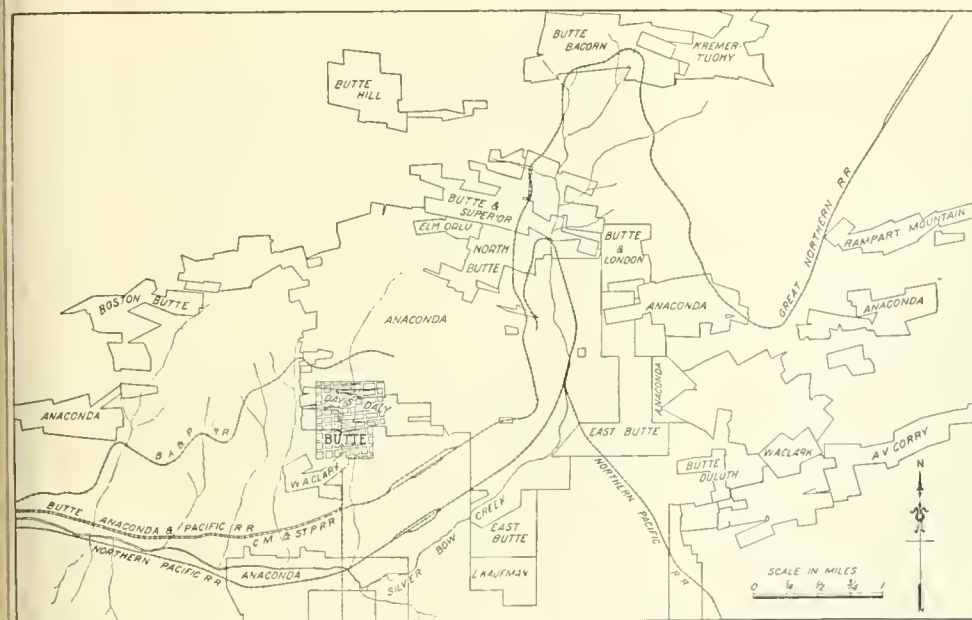
Neihart.—New ore-shoots on the 200 and 300-ft. levels of the Neihart Consolidated mine have been opened recently, according to Dan Tracy, president of the company. Forty men are employed. During December nine cars of ore that netted the company \$25,000 were shipped to the smelter.

NEVADA

Carson.—The Nevada chapter of the American Association of Engineers has prepared for presentation in the legislature an act creating a State board to examine and license mining, mechanical, civil, and electrical en-

gineers. The act provides for a board of five examiners, consisting of the dean of the college of engineering of the University of Nevada and four others, one from each branch of the profession covered by the act. Provision is made for the exchange of courtesies with other States.

Eureka.—Work in the Locan shaft was resumed by the Ruby Hill Development Co. last Monday, and, according to the plans of the company, will be continued until a depth of 1700 ft is attained. At that depth the geologists of the company expect to find a permanent water-level and sulphide ore, in the lower wedge of limestone, north-east of the great Ruby Hill fault-fissure.—The shipments from Eureka district for the last week to the Utah smelters, were as follows: From the Eureka-Holly mine, four cars; from the Eureka-Croesus mine, five cars; and from the Eureka Con. and Richmond Con. Reduction Works 24 cars of speiss.—Over 30 men are now employed on the milling plant of the Eureka-Holly Mining Co. The machinery for the mill is all on hand and nearly all in place, but delay is occasioned by the non-arrival of fire-brick for the volatilization furnaces.—F. L. Torres, president and general manager of the Eureka-Croesus Mining Co., announced the intention of his company to build a mill for the treatment of low-grade ore



PROPERTY MAP OF THE BUTTE DISTRICT

livered to Kellogg and will be taken to the mine as rapidly as possible. All preliminary and outside work for driving a 1400-ft. cross-cut has been completed and the adit is now in nearly 100 ft. The total length will be 1493 ft., which will give a vertical depth of 646 ft. on the Jim Blaine vein. Two other veins will be crossed in this work, the Bristol and the Midnight, both of which have been explored in their upper levels with good results.

MISSOURI

Joplin.—A number of producers of zinc ore have been invited to attend the meeting of the Southern Tariff Association, to be held at Atlanta, Georgia, January 27, 28, and 29. The purpose of the Congress is to discuss public policies, especially with respect to tariff questions that have to deal with the welfare of the Southern States, including Missouri, New Mexico, and Arizona, where the mine-owners are greatly interested in the probable tariff on metals.

MONTANA

Butte.—The Butte & Superior company has increased the capacity of its No. 3 hoist to operate at a depth of 5000 ft. No. 3 shaft is now 2300 ft. deep and a cross-cut to the Rainbow lode has been completed. Drifting has given encourag-

test spring if a suitable process can be found. After a number of experimental tests on the gold-silver-lead products from the Eureka-Croesus mine, the company has decided that they have found a method that will prove effective for the treatment of the high and low-grade ores combined.

Las Vegas. The Martin-Ronnow gypsum mine, seven miles north east of Las Vegas, has been sold to J. H. Pierce, of Los Angeles, for a price reported to have been \$25,000. It is said that a narrow-gauge railroad is to be built from the mine to Las Vegas, that a reduction plant is to be built, and that 100 tons of ore will be shipped daily.

Reno. Ore assaying from \$25 to \$75 per ton in silver, copper, and gold has been opened on the 300-ft. level at the mine of the Standard Metals Co. The mill is being put in shape for operation, according to A. L. Chappell, manager.

An inclined shaft has been sunk for 65 ft. in a shoot of high-grade silver ore on the Hager-Keefer property. The shaft of the Black Panther mine has reached a depth of 220 ft. and will be sunk to the 500-ft. point.

Virginia City.—The Comstock-Florida company, of which G. S. Clark is president and general manager, is cleaning up the old tunnels and drifts on the Florida group of claims, preparatory to a thorough exploration of the property.

NEW MEXICO

Lordsburg.—The total ore-shipments from the district during the month of December 1920 amounted to 73 carloads, or 3575 tons of an approximate value of \$70,000. The total ore output for the year 1920 was 1108 carloads or 56,284 tons of approximate gross value of \$1,125,680.

OREGON

Grants Pass.—The recent sale of the Boswell mine to Thomas Norden and associates of Seattle has resulted in the incorporation of the Boswell Mining Co. The new owners will erect modern equipment on the property at once. This mine is situated 30 miles south of Grants Pass in the Sucker Creek district, a comparatively new gold-producing area in this region. From the present working, which is not over 20 ft. in depth, \$46,000 in gold has been taken.

A decree in the Circuit Court of this county in the suit of Rowan v. Barton is in favor of Barton and associates. Two years ago a receiver was appointed for certain chrome mining properties and the personal property held by the Bartons, upon the petition of Rowan, who alleged that a partnership existed between the Bartons and himself and that he was entitled to a portion of the proceeds from the chrome mines. By order of the Court appointing a receiver assets totaling some \$50,000 were tied up. The decree released all of this property and holds that a partnership never existed, that Rowan has no interest in the proceeds from the war-time mining operations of the Barton brothers, and that the appointment of a receiver was wrongful.

WASHINGTON

Stevens County.—Between 400 and 500 men have been laid off by the three big magnesite companies at Valley, 50 miles north of Spokane. These are the Northwest Magnesite Co., the American Minerals Production Co., and the American Refractories Co. Unfortunately this constitutes a real shut-down and not merely a curtailment, as, with the exception of the American Mineral Production Co., no production whatever is being made, the few men still left being employed simply in repairs. The exception noted is the running of a small pioneer kiln which produces some 100 to 150 tons per month of calcined magnesite for the Eastern flooring and stucco trade. A large kiln is practically completed, with a capacity of 1000 tons per month. Austria is now supplying nearly the entire demand in this country, and the shut-down will undoubtedly last till a protective tariff is secured.

PERSONAL

The Editor invites members of the profession to send particulars of their work and appointments. The information is interesting to our readers.

Charles Janin has gone to Washington.

Harry H. Webb is at the Fairmont hotel.

G. C. Bateman has moved from Toronto to Cobalt.

W. A. Carlyle has returned from England to Ottawa.

Frank E. Nye, of Boston, is at Rattle Mountain, Nevada.

Donald F. Irvin will sail from New Orleans on February 9 for South America.

John A. Burgess is making a geological examination at Searchlight, Nevada.

H. G. Nichols is now with the Canada Copper Corporation, at Copper Mountain, B. C.

Charles Butters sailed from San Francisco on January 19 on his way to Iquique, Peru.

D. W. Branton left Denver on January 16 on a pleasure tour to the West Indies and Panama.

G. A. Joslin, of Salt Lake City, was in San Francisco this week on his return from Los Angeles.

James Frame has left Boston to examine silver mines near Chalchihuites, in Zacatecas, Mexico.

Will H. Coghill, of the U. S. Bureau of Mines, is studying the sludge problem in the Wisconsin zinc region.

Amor F. Keene, of New York, was here last week on his way to the La Grange mine, near Weaverville, California.

Livingston Wernecke, in charge of prospecting operations for the Treadwell companies in Alaska, was in San Francisco last week.

A. W. Allen has arrived in New York on his way from Chile by way of London. He is expected in San Francisco next week.

A. E. Drucker has accepted an appointment on the faculty of the University of Illinois, Department of Mining Engineering, to take effect on February 1.

O. Hallingby, formerly superintendent for the La Salle Mining Co., has become a member of the faculty of the Michigan College of Mines at Houghton.

C. H. Munro, who returned recently to San Francisco from the Federated Malay States, is returning thither on a two-years contract with the Yukon Gold Company.

C. V. Corless, manager for the Mond Nickel Co., has been nominated for president of the Canadian Institute of Mining and Metallurgy. He sailed for London on December 29, but will return shortly.

R. T. White, formerly manager for the Balaklala Copper Co., was in San Francisco this week on his way from Chile, where he was the manager for the A. S. & R. Co., and has left for a holiday in Florida.

C. H. Macnutt has resigned the resident management of the Black Lake Asbestos & Chrome Co. to take charge of the Vimy Ridge property of the Bennett-Martin Asbestos & Chrome Mines, at Coleraine, in Quebec, Canada.

Herman Garlicks, a notable metallurgist, died on January 8 at his home in Brooklyn, New York, at the age of 61. He was born at Brooklyn in 1859, his father being then the pastor of a Lutheran church. After graduating from the Columbia School of Mines, in 1880, he went to Colorado and worked as a U. S. Deputy Mineral Surveyor. Between 1884 and 1908 he served as metallurgist at a number of important smelters, including those at Aurora, Denver, Velardeña, Kansas City, and Newark. During the War he worked for the Government as advisory metallurgist at 'a dollar a year'. He was a man of high integrity and kindly character, and will be mourned by many friends in the West.

THE METAL MARKET



METAL PRICES

San Francisco, January 18

aluminum-dust, cents per pound	65
antimony, cents per pound	9.50
copper, electrolytic, cents per pound	14.00—14.50
lead, pig, cents per pound	5—6
latinum, pure, per ounce	\$73
latinum, 10% iridium, per ounce	\$103
quicksilver, per flask of 75 lb.	\$50
zinc, cents per pound	8.25
tin-dust, cents per pound	12.50—15.00

EASTERN METAL MARKET

(By wire from New York)

January 17.—Copper is quiet and firmer. Lead is active and stronger. Tin is dull and easy.

SILVER

Below are given official or ticker quotations for silver in the open market distinguished from the fixed price obtainable for metal produced, smelted, and refined exclusively within the United States. Under the terms of the Pittman Act such silver will be purchased by the United States Mint at \$1 per ounce, subject to certain small charges which vary slightly but amount approximately three-eighths of one cent. The equivalent of dollar silver (1000 fine) in British currency is 46.65 pence per ounce (925 fine), calculated at the normal rate of exchange.

	New York cents	London pence	Average week ending Cents	Pence
Jan. 11	65.25	39.50	Dec. 6	69.08
" 12	66.00	40.00	" 13	62.54
" 13	65.87	39.87	" 20	63.77
" 14	66.37	40.00	" 27	63.77
" 15	67.25	40.75	Jan. 3	65.40
" 16 Sunday			" 10	66.60
" 17	66.12	39.87	" 17	66.14

Monthly averages

	1918	1919	1920	1918	1919	1920
Jan.	88.72	101.12	132.77	July	99.62	106.36
Feb.	85.79	101.12	131.27	Aug.	100.31	111.35
Mar.	88.11	101.12	125.70	Sept.	101.12	113.92
Apr.	85.35	101.12	119.50	Oct.	101.12	119.10
May	99.50	107.23	102.69	Nov.	101.12	127.57
June	99.50	110.50	90.84	Dec.	101.12	131.92

COPPER

Prices of electrolytic in New York, in cents per pound.

	Average week ending
Jan. 11	13.00
" 12	13.12
" 13	13.12
" 14	13.12
" 15	13.12
" 16 Sunday	
" 17	13.12

Monthly averages

	1918	1919	1920	1918	1919	1920
Jan.	23.50	20.43	19.25	July	26.00	20.82
Feb.	23.50	17.34	19.05	Aug.	26.00	22.51
Mar.	23.50	16.05	18.49	Sept.	26.00	22.10
Apr.	23.50	15.23	19.23	Oct.	26.00	21.66
May	23.50	15.91	19.05	Nov.	26.00	20.45
June	23.50	17.53	19.00	Dec.	26.00	18.55

LEAD

Lead is quoted in cents per pound, New York delivery.

	Average week ending
Jan. 11	5.00
" 12	5.05
" 13	5.15
" 14	5.15
" 15	5.15
" 16 Sunday	
" 17	5.15

Monthly averages

	1918	1919	1920	1918	1919	1920
Jan.	6.85	5.60	8.65	July	8.03	5.53
Feb.	7.70	5.13	8.88	Aug.	8.05	5.78
Mar.	7.26	5.24	9.22	Sept.	8.05	6.02
Apr.	6.99	5.05	8.78	Oct.	8.05	6.40
May	6.99	5.04	8.55	Nov.	8.05	6.76
June	7.59	5.32	8.43	Dec.	6.90	7.12

TIN

Prices in New York, in cents per pound.

	1918	1919	1920	1918	1919	1920
Jan.	85.13	71.50	62.74	July	93.00	70.11
Feb.	85.00	72.44	59.87	Aug.	91.33	62.20
Mar.	85.00	72.50	61.92	Sept.	80.40	55.79
Apr.	88.53	72.50	62.17	Oct.	78.82	64.82
May	100.01	72.50	54.99	Nov.	73.67	54.17
June	91.00	71.83	48.33	Dec.	71.52	54.94

ZINC

Zinc is quoted as spelter, standard Western brands, New York delivery, in cents per pound.

Date				Average week ending	
Jan. 11	6.00			Dec. 6	6.14
" 12	6.00			" 13	6.42
" 13	6.00			" 20	5.89
" 14	6.00			" 27	5.56
" 15	6.00			Jan. 3	6.04
" 16 Sunday				" 10	6.00
" 17	6.00			" 17	6.00

Monthly averages

	1918	1919	1920	1918	1919	1920
Jan.	7.78	7.44	9.56	July	8.72	7.78
Feb.	7.97	6.71	9.15	Aug.	8.78	7.81
Mar.	7.67	6.53	8.93	Sept.	9.58	7.57
Apr.	7.04	6.49	8.76	Oct.	9.11	7.82
May	7.92	6.43	8.07	Nov.	8.75	8.12
June	7.92	6.91	7.92	Dec.	8.49	8.69

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, according to quantity. Prices, in dollars per flask of 75 pounds.

Date	1918	1919	1920	1918	1919	1920
Jan. 21	50.00			July	50.00	50.00
Dec. 25	50.00			" 11	50.00	50.00
				" 18	50.00	50.00

Monthly averages

	1918	1919	1920	1918	1919	1920
Jan.	128.06	103.75	89.00	July	120.00	100.00
Feb.	118.00	90.00	81.00	Aug.	120.00	103.00
Mar.	112.00	72.80	87.00	Sept.	120.00	102.60
Apr.	115.00	73.12	100.00	Oct.	120.00	86.00
May	110.00	84.80	87.00	Nov.	120.00	78.00
June	112.00	94.40	85.00	Dec.	115.00	95.00

OIL-WELLS IN THE UNITED STATES

The number of producing oil-wells in the United States on October 31, 1920, was approximately 258,600, according to figures compiled by the U. S. Geological Survey. Production averaged 4.98 bbl. each per day. On this basis production of the wells for one year would be 463,680,000 barrels.

The largest number of producing wells is in Pennsylvania, which is credited with 67,600, and here the smallest average production is recorded, namely, 0.3 bbl. (approximately 12 gal.) per well per day, with the exception of New York, an unimportant producing State. Oklahoma has 50,700 producers, with average daily output of six barrels per well. Ohio is third with 39,600 wells producing five barrels daily per well.

Texas and California, which were the leading producing States in November, with a total output of 9,489,000 bbl. and 9,340,000 bbl., respectively, have both a comparatively small number of wells, but with large average production. Texas has 11,100 wells, 9400 of which are in north and central fields and 1700 in Gulf Coast. North and central producers have an average daily output of 22.9 bbl. each, while those in the Gulf average 49.7 bbl. Californian wells number 9490 and average 32.3 bbl. each.

The following table shows the approximate number of producing oil-wells, by States, as of October 31, 1920; the approximate production of each well per day; and the estimated total production by States for November, giving an idea of comparative importance of the States as producers:

	Number of producing wells	Daily average output, bbl.	November actual output, bbl.
Texas, central and north	9,400	22.9	6,714,000
Gulf Coast	1,700	49.7	2,775,000
Total, Texas	11,100	27.0	9,489,000
California	9,490	32.3	9,340,000
Oklahoma	50,700	6.0	9,031,000
Kansas	15,700	7.4	3,578,000
Louisiana	2,700	31.8	2,015,000
Wyoming and Montana	1,000	55.9	1,432,000
Illinois	16,800	1.7	846,000
Kentucky	7,800	3.2	734,000
West Virginia	19,500	1.1	656,000
Pennsylvania	67,600	0.3	603,000
Ohio	39,600	5.0	602,000
Indiana	2,400	1.1	81,000
New York	14,040	0.2	75,000
Colorado	70	4.1	8,000
Total	258,600	4.98	39,090,000

MONEY AND EXCHANGE

Foreign quotations on January 18 are as follows:

Sterling, dollars:	Cable	3.77
	Demand	3.78
France, cents:	Cable	6.38
	Demand	6.40
Libre, cents:	Demand	3.57
Marks, cents		1.69

Eastern Metal Market

New York, January 12.

Practically all the markets, except perhaps zinc, are stronger in tone but prices are not substantially higher though the tendency is in that direction.

Copper demand is a little better and the price situation a little stronger.

The pronounced strength in sterling exchange has stimulated prices in tin.

The lead market is growing stronger each day and prices are higher.

Demand for zinc remains quiet but the price-level is stationary.

Antimony is inactive.

IRON AND STEEL

Ten days of the new year have brought little change in the rate of mill operations or in the buying of steel. A few plants which shut-down completely before the holidays have resumed in part, but it is frankly said that even such activity will be short lived unless larger demand develops this month. The Steel Corporation continues to operate most of its mills at more than 90% of full capacity, with indications that this condition will be maintained through the winter.

How long the Steel Corporation price level will be held is the uppermost question. In the few tests that have come, the corporation has adhered to its schedule, though on plates in particular other makers have quoted 2.50c., representing a cut of \$3 per ton.

December steel output fell off but 11% from that of November, so that an ingot production of 40,000,000 tons for 1920 is indicated, against 33,700,000 tons in 1919.

COPPER

The improvement in the market is one of sentiment rather than demand. The better feeling is pronounced but is probably largely psychological. It may be said, however, that the price situation is firmer, the cheaper lots and quotations having largely disappeared. There is less tendency to cut values or to scramble for business. Inquiry is also on the mend. In the face of the fact that heavy consumers are well stocked with 15 to 18c. metal and that business is still slack in finished lines, no buying of consequence is looked for in the near future. We quote the market for electrolytic copper at 13c., New York, for early delivery, and at 13.25c. for first quarter, with Lake copper at 13.25c. and 13.50c. for the same respective positions.

TIN

There has been a marked improvement in this market. Consumers and dealers have entered the market and there has been a revival in buying of some proportions. Early last week sales were made of shipment from London and of future shipments from the East and at the time more could have been sold, but no large quantities were offered. There was a fair number of sellers and competition was quite keen. As the week progressed, demand broadened until toward the end the market turned sluggish, due to higher prices in London and the value of sterling. Sentiment is decidedly better. On Monday, this week, there was more inquiry from which some sales resulted. The quotation for spot Straits has steadily advanced the last week until yesterday it stood at 38.75c., New York, against 36c. a week ago. A strong factor has been the sharp rise in the pound sterling which is predicted to go to \$4 soon. Arrivals thus far this month have been 265 tons with 2400 tons reported afloat. A feature of the annual tin statistics is the 1920 output of American electrolytic tin which was 14,513 tons against 11,596 tons in 1919, and only 3845 tons in 1916.

LEAD

This market is the strongest and most active of any. There exists a good demand which has resulted in substantial sales. As a result prices in the outside market have hardened until they are higher than the leading interest. The latter still quotes 4.75c., New York, but an advance has been expected before this. It is believed that this is a nominal one and that the American Smelting & Refining Co. is not taking any orders. We quote the outside market firm at 5c., New York, and 4.85c., St. Louis. Advice from one dealer is to the effect that the London market should be carefully watched so as to avoid too rapid an advance here even if no large surplus has recently been accumulated. This course may forestall further imports.

ZINC

This market is the most sluggish of all. Demand does not increase and there seems very little present prospect of a buying-movement. A stronger market in London is the most encouraging feature, as well as the fact that domestic production is cut down and that prices are below cost. Such relations cannot continue for a long period. Galvanizers are not busy and hence buying is only for prompt needs and producers of zinc are not eager sellers. We quote prime Western for early delivery at 5.50 to 5.60c., St. Louis, and 6 to 6.10c., New York. Quotations for forward positions are not freely given if at all.

ANTIMONY

The market is very dull with wholesale lots for early delivery unchanged at 5.20 to 5.25c., New York, duty paid.

ALUMINUM

This market is quiet and unchanged with virgin metal, 99 to 99% pure, quoted in wholesale or 15-ton lots for early delivery at 28.30c. f.o.b. producer's plant by the leading interest and at 22 to 23c., New York, by other sellers.

ORES

Tungsten: There is almost no business. Dealers and speculators are doing a little. The advance in the pound sterling has stiffened quotations and made them at least firmer. The ferro-tungsten market is also quiet and unchanged.

Molybdenum: There is no market. In the absence of any buying no quotations are available.

Manganese: Stocks are heavy and prices entirely nominal around 40 to 45c. per unit, seaboard, though this has been and can be shaded in special cases.

Manganese-Iron Alloys: The ferro-manganese and spiegeleisen markets are stagnant and prices are nominal. For the former \$110, seaboard basis, is the asking price with \$40 furnace, the quotation for spiegel, but this can be and has been shaded. Re-sale ferro-manganese has sold around \$90 to \$100, but an offer of \$98 the last week did not bring off any alloy.

Under date of January 11, the market letter of Srinivas R. Wagle says: "The market for silver opened firm, owing mainly to the support from India. The advance in the London price since the close of last week was only 1/4d., but the heavy rise in sterling exchange made New York very firm. Owing to the arrivals of small amounts from the Continent and speculative activity in China, the market declined an closed weak. The Chinese markets were fairly active. Speculative sales tended toward weakness, although the closed steady. The silver stock in China is unchanged."

INDUSTRIAL PROGRESS



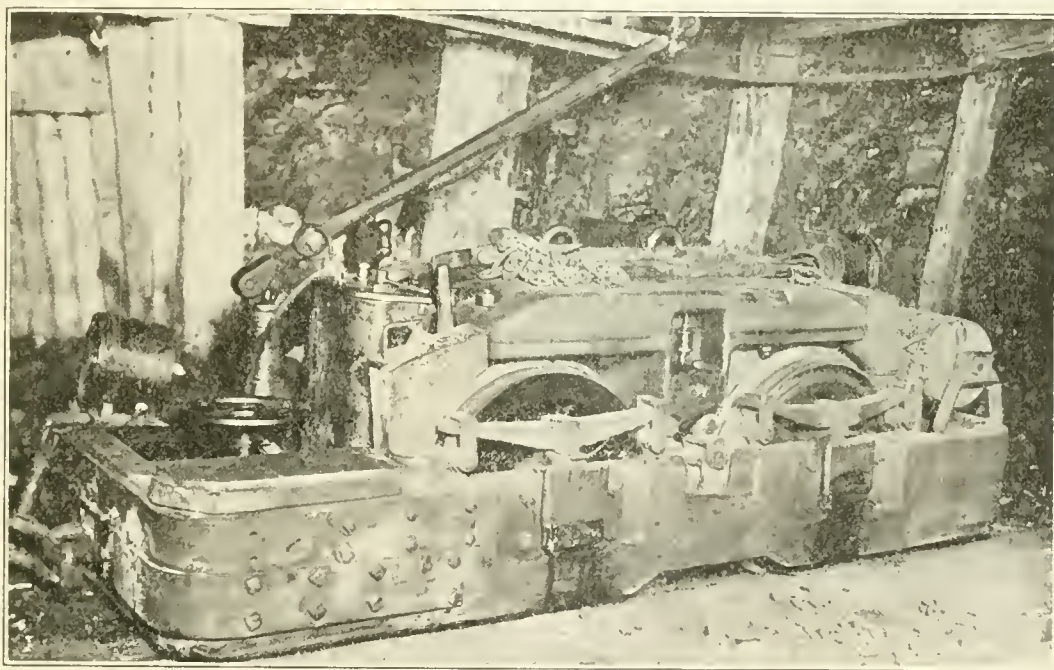
INFORMATION FURNISHED BY MANUFACTURERS

A RECORD OF LONG SERVICE FOR MINE-LOCOMOTIVES

An electric mine-locomotive that has a unique record for longevity and service is at present operating in the mine of the Union Pacific Coal Co. at Rock Springs, Wyoming. The locomotive was built by the Thomson-Houston Co. and was put in service at its present location 27 years ago. It has been giving continuous service ever since, records kept by the coal company showing that it has hauled 3,712,500 tons

been used on a very rough road, but there has been comparatively little trouble due to the breakage of springs.

It has also the low record among the locomotives used in the mines of this company for repair charges, and consequently in cost per ton of coal hauled. In fact it is held to be just as efficient in operation as any of the recently designed locomotives in their service. The feature that is held largely responsible for the low upkeep is the use of the semi-elliptical leaf-spring construction. It is interesting to



Electric-Locomotive at the Union Pacific Coal Mine

of coal over an average distance of 1.5 miles in that time, or a total of 5,568,700 ton-miles.

The locomotive is type GLM-30-6 terrapin back, 500-volt, with a speed of eight miles per hour. Its capacity is 9 tons, with a 3000-lb. draw-bar pull, and the wheel diameter is 38 inches.

The locomotive is equipped with one motor having a single field-coil and the old Gramme ring armature. The original field-coil is still in service and has never given any trouble. Two armatures have been used, one the original furnished when the locomotive was bought, and another spare one. The commutators are very much smaller than those used at the present time for 500 volts, and five of them have been worn out in service. The original control was the semi-circular disc type, which has since been abandoned. The present control is an R-22 controller and a Jeffery pan-ke resistor. The original brake rigging is still in service, and the gears have also given excellent service, as only three of them have been worn out.

The locomotive is equipped with semi-elliptical leaf-springs, which support its weight on the journal-box. It has

note in this connection that the General Electric Co. has returned to this design in its locomotives, with the addition of an equalizer-bar to distribute the weight more evenly.

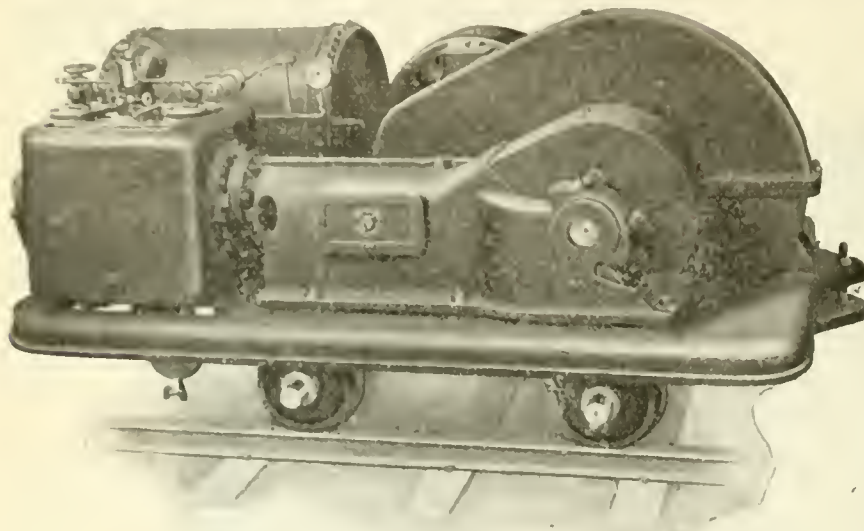
CHICAGO PNEUMATIC MINE-CAR COMPRESSORS

The air-compressor outfit illustrated has been designed particularly for the mining industry. Its usefulness is not confined to that field, since quarries and large construction projects having a system of narrow-gauge tracks will find a large and varied use for this machine. The flexibility and economy of this outfit are obvious, since the car can be moved to the point of distribution, resulting in the elimination of line-losses and troublesome and expensive systems of piping. Leakage and friction losses are inevitable where the air is used at a great distance from the compressor, and where the piping is of a temporary nature and subject to abuse, as is frequently the case in newly worked portions of a mine, the line-losses are enormously high. The economy effected by the elimination of these losses far more than offsets the difference in efficiency between one large unit

and a number of small units, to say nothing of the convenience of the portable outfit and the saving in time, expense and trouble in laying air-lines in newly worked sections of the mine.

The outstanding features of Chicago pneumatic compressors are ruggedness, simplicity, efficiency, totally enclosed construction and 'implant' flat-disc air-valves. The compressor is of the horizontal single-stage type and possesses all of the superior features of the company's standard straight line compressors. It is hopper water-cooled and geared to an electric motor by means of a sturdy herring-bone gear and pinion. The complete outfit, consisting of compressor, air-receiver, 'differential' unloader, electric motor, and starter, is mounted on a substantial mine-car which is readily adjustable to suit any track gauge commonly found in mines.

The compressor is driven by an electric motor, through herring-bone gear and pinion. The gear is cut from a solid cast-iron disc of sufficient weight to give the proper fly-



Compressor Mounted on Mine-Car

wheel effect. The pinion is of forged steel. It is a well-known fact that herring-bone gears run more smoothly than spur gears, and also work silently without vibration. The gear and pinion are entirely enclosed by cast-iron gear-case, and run in a bath of semi-fluid grease which partly fills the bottom half of the case.

The customary electrical equipment includes a 230-volt direct-current moisture-proof motor of standard make, a suitable hand-starter with low voltage release, and a line-switch properly fused to provide overload protection. Electrical equipment can also be supplied for alternating current of any standard voltage. Suitable drip shields are provided to prevent water from dripping from the roof of the mine onto the motor or equipment.

A horizontal receiver, made from 60,000-lb. tensile-strength steel, is clamped to the deck of the car by two steel straps and is furnished with a pressure-gauge and pop-valve, set to 110 lb. pressure.

The compressor and equipment are mounted on a sturdily constructed mine-car having a strongly ribbed deck. The car is provided with forged steel axles of such length that the wheels can be adjusted to run on 36 to 42-in. gauge tracks. The wheels are of cast-iron, bushed with bronze bushings, and are held in position on the axles by adjustable collars. The wheel base is sufficiently short to readily negotiate sharp curves.

N. E. Otterson has been appointed Eastern manager for the Clyde Iron Works Sales Co. distributors of hoisting machinery manufactured by the Clyde Iron Works of Duluth, Minnesota.

CONCERNING WELDED TANKS

"The manufacturers of rectangular welded tanks," writes a mechanical engineer in recent issues of 'The Boiler Maker' and 'The Welding Engineer', "are apparently following the same designs for the staying as were used when the tanks were riveted. The result is that the tanks fail by opening the welds at the corners, which soon commence to leak and, not being repairable, have to be scrapped . . . Unfortunately there is no practicable way of repairing a welded joint."

Human expression falls easily into the general statement form, and it is not surprising that conclusions supported by superficial evidence are often in error, as there is always danger of confusing the exception with the rule. This appears to have occurred in the deductions drawn in the above statements. That the conclusions had for their basis only the weakness of an isolated instance, a solitary second-hand tank of a type made before special engineering study had been applied to welded tank construction, seems certain from subsequent statements in a letter written by the author of the original published article.

"I regret to be unable to say," writes the engineer, "which process was used in welding the tank mentioned in my article. This tank was used to hold the feed-water on a steam-shovel, and both shovel and tank were second-hand when they came under my attention.

"Speaking from memory, I should say the tank was about 10 ft. high, 6 ft. long, by 2½ ft. wide, of ¾-in. plate, and of practically rectangular shape. The tank was open at the top, or rather I ought to say there was a hole about 18 in. diam. in the top plate, and it was filled with water about once per day, and the boiler was fed from it as required. The pressure on the sides was only that due to the head of water, that is, 10 ft. as a maximum; but the bracing was so badly designed that the bulging of the sides was quite perceptible

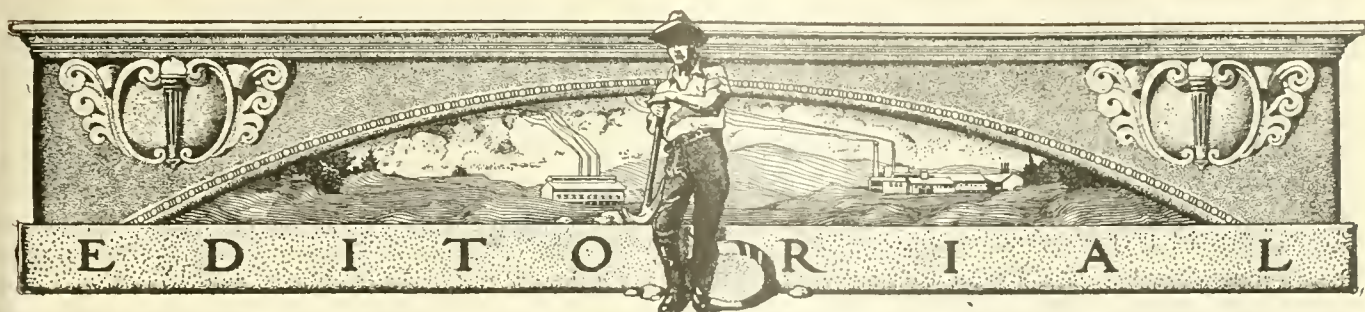
when the tank was being filled."

In the words of a welding-engineer to whom this letter was referred: "That is certainly the most superficial basis for damning an industry that has ever come to my attention!"

Of course the author-engineer had no intention of "damning an industry", as evidenced in another of his statements, namely: "This gives the welded tank a bad reputation—which it does not deserve, the fault being entirely with the weakness of the bracing." Basing his assumption that all welded tanks are poorly braced on the premise of the single instance cited, he proceeded with the development of a series of equations to determine the bracings necessary under varying conditions as to dimensions, materials, and pressures.

The welding industry will not pass unchallenged the inference that weakness is inherent in welded-tank construction. Quite a contrary position will be taken by those engineers who have specialized for some years past in the application of welding to manufacture of tanks. Tanks welded by the oxy-acetylene process are being built in many parts of the United States, and they are at once so economical and so satisfactory that they are very largely displacing riveted tanks. They withstand very much greater pressures than the water pressure in the tank previously noted, and after proper test and inspection are accepted everywhere as the highest type obtainable in tank construction.

It should be made very clear, and it cannot be too positively stated, that welded joints can be repaired, and very easily and effectively, by the oxy-acetylene flame, though the occasion for such repairs, as welded tanks are now constructed, is practically non-existent.



T. A. RICKARD, Editor

TARIFFS on mineral products under Schedule C are being asked from Congress as follows: 10 cents per pound on antimony in ore, matte, and antimonial lead; 50 cents per pound on molybdenite in ores and concentrates, with \$1 on the molybdenum in alloys; 50 cents per pound on quicksilver; \$10 per unit of tungstic oxide in ores, concentrates, or compounds, with \$1 per pound on the tungsten in ferro-tungsten; two cents per pound on lead in whatever form imported; and two cents per pound on the zinc in ores containing 25% of zinc or more, 1½ cents per pound if the ore assays under 25% in zinc; 2¾ cents on zinc in blocks, pigs, zinc oxide, pigments not containing lead, and 3¼ cents on zinc in sheets, strips, plates, or coils. Hearings before the Ways and Means Committee are being held for the purpose of obtaining information on the supposed need for these tariffs.

THE existence of the Mining and Metallurgical Society of America is made known annually by its bestowal of a gold medal on some worthy member of the profession. This year this society has done itself proud, as the saying goes, by awarding its medal to Mr. Charles W. Goodale "for his distinguished service in increasing safety in mining and metallurgical operations", more particularly at Anaconda. We can think of several reasons for giving Mr. Goodale a medal, the chief of which is that all his life he has been an exemplar of all that is honorable and of good report in a mining engineer. The Society has also distinguished itself by electing Mr. J. E. Spurr as president in succession to Mr. Waldemar Lindgren. We are compelled to acknowledge that, although we demur to the continued existence of the Society, which we deem supernumerary as an organization of technicians, we concede gladly that it consists of a coterie of men in whose company we would be glad to find ourselves at any time.

BIG men sometimes say small things. Mr. Charles M. Schwab in a public speech refers to the Panama Canal tolls and deplores the fact that "at present our ships must pay the same tolls at the Panama Canal as ships of nations that did not spend one cent to build it and are not contributing one cent of taxes to maintain it! It is said that a certain treaty makes this necessary. Well, if I had the handling of the situation, I'd damn soon get rid of the treaty!" As if the honor of the United States

were not worth more than any amount in tolls, and as if our Government were to regard a treaty to which it had signed the name of this nation as another "scrap of paper". If it be inequitable, it will be proper to ask for a re-consideration and possible friendly amendment of the treaty, but for a man in Mr. Schwab's position to propose without further reason to "damn soon get rid of it" is a very different thing and one that proves him unfit for leadership in national affairs. Public men should refrain from making careless statements; their status carries with it a measure of personal responsibility that they are not warranted in ignoring.

A DISPATCH from Washington says that the House Committee on Appropriations has authorized the expenditure of \$3900 for the continuation of the U. S. Assay Office at Salt Lake City during the year 1921. Mr. Raymond C. Baker, Director of the Mint, reported that during the past year \$20,219 worth of gold and silver had been received at the Salt Lake office and that the expenses had been \$4172 and the earnings \$743; he recommended, quite rightly, that the office be discontinued since bullion can be sold either in San Francisco or in Denver. Obviously the refinery-man at Salt Lake City must be in a state of innocuous desuetude most of his time. The only possible reason for such performances on the part of Congress is to make soft jobs for the friends of good political wire-pullers. We know nothing of the personnel of the staff of the Salt Lake assay-office and our criticism is entirely impersonal; the trouble is with the system that makes such unjustifiable appropriations possible. The fact that the amount is small does not make the glaring waste of public money any less reprehensible, especially at a time when the Government should be setting an example of thrift.

PASSAGE of the bill providing for appeal to the Court of Claims on the part of dissatisfied War Minerals claimants has been opposed by the Secretary of the Interior in a letter to the House Committee on Mines and Mining. The Secretary, Mr. John Barton Payne, says that his department has given the claimants every opportunity to present their cases and has endeavored to reach a just and equitable conclusion under the law. Serious controversy has arisen over the interpretation of the phrase "request or demand", in which the Secretary of the Interior has followed the opinion given by the At-

torney General, as also over the question whether the purchase price of a mine be compensated under the Mineral Relief Act. Mr. Payne considers the pending bill, for appeal to the Court of Claims, too broad; it would, he thinks, permit a re-examination of all claims. "It is doubtful", he says, "especially in view of the completion of the work, whether any further legislation is wise; but if Congress thinks it is, I suggest the appeal be limited to questions of law, and that further appeal be allowed to the Supreme Court". Mr. Payne, we may mention, is a lawyer by profession. He asserts that the "large majority" of the claimants are satisfied and that the Commission has "endeavored to carry out the law in a liberal spirit". That is a matter of opinion; we happen to have heard many opinions of a contrary nature. The Attorney General's dictum as to "request or demand" seemed to us, and still seems to us, mistaken and inequitable, and an attempt on the part of the Government to evade a just obligation.

ELSEWHERE in this issue we publish a brief but interesting article by Mr. Will H. Coghill, in which he urges that the Western engineering schools model their methods of instruction after the colleges and universities in the Eastern States; and he criticizes with good grace, since he declares that he himself is a "victim of the drop-forging system", as he styles the Western plan. His principal objection is the tendency to " cram " the student with "practical courses" to the exclusion of economic and purely cultural subjects that are part of a liberal education. We discussed this question at some length in our issue of August 14, advancing the opinion that engineering curricula in all our mining schools, both East and West, were being revised to include more of these non-technical courses. Mr. Coghill presents some interesting data showing the proportion of graduates from Columbia, the Massachusetts Institute of Technology, and three unnamed Western schools that had been honored by 'Who's Who' for 1913-1914. The figures, beginning with Columbia, as expressed in percentages are 8.3, 4.4, 0.8, 0.7, and 0.0. Some might be inclined to question whether enumeration in the exclusive pages of 'Who's Who' is the best test for determining the successful mining engineer, but granting that it is, we venture to suggest one point that may invalidate the conclusion appearing on the face of the figures. It will be noted that graduates from 1882 to 1905 are included; but, whereas Columbia and Massachusetts began graduating engineers in the early 'eighties and had a number of engineering alumni by 1895, it is doubtful if the Western schools, the identity of which we can only surmise, had more than a dozen graduates prior to 1895, if indeed they had any at all. Accordingly, the older institutions would have a decided advantage in view of the fact that the reputation and prominence enjoyed by the elect of 'Who's Who' generally are attained in the years of maturity. A fairer comparison apparently would be obtained if only the men finishing their college course since 1900 were considered. The large university, with its rich tradition,

affords the student evident advantages that are not to be had in the smaller and newer school of mines; it has the stimulating atmosphere of culture and learning; it can attract the mature, the brilliant, and the inspiring teacher; it gives its graduates a certain prestige. These things may help, but in the end the result of any education depends largely on the individual himself; the good that he gets from his school and university will be just about proportionate to the energy and effort he applies regardless of those who direct the work; and if his education ends with his college days, if he stops studying when he obtains his sheepskin, he will never make any great success as an engineer whether his alma mater be Columbia, Chicago, Houghton, Golden, or California. We are inclined to think that the excellent educators who are in charge of most of our Western mining schools realize their disadvantages as well as their advantages; that they recognize their shortcomings; that they are alive to the progress being made elsewhere; and that they are striving to make improvements as earnestly as the administrators of the larger institutions in the East; indeed it is quite possible that many changes have been made at Mr. Coghill's own school since he and his classmates received the impress of the die in the "drop-forging" process.

The Irish Question

We happen to know something about the British empire, having sojourned in London and Melbourne, and we also know something about the Irish republic, having lived in New York and San Francisco, therefore we venture to refer to the Irish question, which some people are trying, not unsuccessfully, to make an American question. It is a subject that bristles with unpleasant points but it is one that no honest editor can ignore indefinitely even if he might wish to do so, because it is producing consequences much too grave to be disregarded by serious commentators on current events. The foremost objection to agitating the Irish question in the United States is that it introduces a non-American issue among our people and tends to disintegrate national solidarity by inciting a controversy that makes an appeal to racial prejudices at the very time when an earnest effort is being made to Americanize the alien elements in this country. The climax of Irish propaganda is the advocacy of a blood feud between the Irish and the British, all over the world and more particularly in this country, in a speech made publicly in New York by a Mr. Boland, who is described as the secretary of the so-called president of the Irish republic. If this Mr. Boland were to advocate anything so foolish on a platform in Cork or in London it would be none of our business, but that he should incite American citizens of Irish birth to kill American citizens of British birth in the United States is very much our business, as it should be the business of a good citizen. After all, the Irish question is no more our affair than the Santo Domingo or the Alabama question is one for the British. Some of our public men believe it best for us as a nation to keep out of European

entanglements, and they quote Washington in support, yet a group of Senators has seen fit to interfere in the affairs of a friendly nation, and members of the Massachusetts legislature have sent an insulting message to the Prime Minister of that nation, one that only recently was our comrade in arms against the common enemy. A notoriously pro-German editor, Mr. Oswald Villard of 'The Nation', has appointed a partisan committee to enquire into the government of Ireland, and this committee is now in session at Washington. A mob of Irish-Americans flying an Irish flag attacked a club in New York because it celebrated Armistice Day by displaying the British flag in company with the French and American flags. It is not illegal to display a foreign flag, as everybody knows, because we have had as many as twenty of them in public places during recent years. It is illegal to assault a private residence. The leader of the Irish rebellion, a man of Spanish birth and born in New York, has been received formally and given civic honors by the mayors of New York and San Francisco. Now, gentle reader, imagine that corresponding acts had been performed in Great Britain. Suppose the leader of a rebellion in Alabama or Santo Domingo had been given the freedom of the City of London; suppose the editor of the London 'Nation' had appointed an anti-American committee to investigate the lynching of negroes or the exclusion of Japanese; suppose the House of Lords had discussed a resolution criticizing our administration in the Philippines; suppose the legislature of Quebec had sent an insulting message to President Wilson; suppose the Carlton Club in London had been attacked by a mob flying a Japanese flag because the Club had displayed the bear flag of California; suppose a Texan were to make a speech in London advocating a vendetta between the Canadians and the British. Try this on your piano, Mr. Reader, and see how you like the tune! The imagination of any sensible man, of course, recoils at these suppositions; to state them is to make them a nightmare of criminal absurdity. Yet their converse has actually happened. Is it not time to call a stop to the Irish propaganda in our midst? Ireland has wrongs and we deplore them; the Irish are unfortunate in their relations with Great Britain, and we regret that; but for the time of a generation the Liberal statesmen of England have tried honestly and persistently to arrange their troubles, and many, from Gladstone down, have wrecked their political reputations in the effort. It is a domestic quarrel, which few of us understand, and it is one in which our interference only makes more mischief, as usually happens when outsiders interfere in a domestic quarrel. We are not helping the cause of the Irish by sowing dissension among our own people; it may fairly be doubted whether we are helping them by irritating the British; we are only introducing a non-American issue in a way to create factional disturbance among ourselves, as if we had not enough difficulties, economic and political, to engage our best attention. Or shall we go on with this European entanglement and boycott all British goods, as has been suggested by sundry gentlemen at Chicago? Before we do that, let us remind ourselves that Great Britain is our

customer to an extent equal to our trade with all the rest of the world put together. This sounds a sordid note; then let us remember that of the British armies in the field, with us, England gave one in every seven of her population; so did Scotland; whereas Ireland gave one in 26. Whether we went into the war to keep the world safe for democracy, or to help England, France, and Belgium, or to resent the insulting acts of Germany—whatever the reason, the fact remains that while our boys were fighting in France the Sinn Feiners were stoning American sailors in Cork. It was not the Irish that did this, only a faction among them, it is true, but it is the appeal of this faction to our hyphenates that is making trouble, and threatening to make it worse. The transfer of European domestic quarrels and racial vendettas to this country is to be reprobated, and even resented, because every time it is done it tends to create a cleavage among us, and that, we submit earnestly, is to hinder, if not to destroy, the Americanization of our heterogeneous population, upon the friendly assimilation of which depends the present welfare and future destiny of this nation.

How Many Hours?

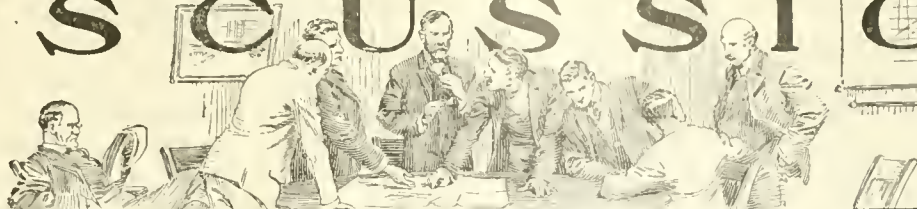
The results obtained by substituting three eight-hour shifts for two of twelve hours each in industries where some of the processes are of such a nature that operation must be continuous are discussed in a recent issue of the 'Journal of the Engineers Club of Philadelphia', a publication, by the way, in which we frequently find something of more than ordinary interest. In the principal paper Mr. Robert B. Wolf presents precise data regarding sundry sulphite paper-pulp mills, in which the old two-shift system had been replaced by three shifts. In one plant the production had been increased from 42,000 to 110,000 tons per year, without the addition of a single digester for cooking the pulp; the quality of the product had been improved from the poorest to the very best; and a net reduction of between \$5 and \$6 in the cost had ensued. Other factors enter into the attainment of this improvement, but Mr. Wolf declares that the mental and physical alertness of the attendants resulting from the introduction of the shorter working period was mainly responsible. Under the older system the men were fatigued and indifferent; neither their physical condition nor their mental attitude was favorable for producing the best quality nor the maximum quantity. The wages paid for eight hours of work were exactly the same as had been paid for twelve hours, so that the improvement necessarily came through increased efficiency on the part of the operators. Mr. Wolf confesses that the change was forced on the officials by the men and that the fortunate outcome from the company's standpoint was entirely unexpected. Mr. Harrington Emerson, one of the deans of our so-called efficiency engineering, gives the following significant statement apropos of a similar change: "Very recently we made a study that covered eight months in one of the large steel mills in the West, where they were considering changing over from twelve hours to eight hours; three different conditions representing three dif-

ferent ideals were accepted. The philanthropists demanded that the hours should be reduced 33%—from the twelve hours to eight. The workers said, 'We are willing to consider the eight hour day provided we get just as much for the eight hours as we before earned in the twelve; if you can accomplish that we shall accept the reduction in hours, but not otherwise. We do not propose to have our daily earnings reduced by any plan such as reducing from twelve hours to eight'. The demand for the eight hours did not come from the workers; it came entirely from the group I have called philanthropists. The third group, the production men, said, 'We have no objection to your going over to eight hours, provided you do not increase cost nor curtail production'. The results of these three conditions were that the plant officials did succeed in reducing hours 33%, that the wages of the men were actually increased per day over 10%, that production increased more than 30%, and the costs of labor and overhead decreased more than 10% !"

These are concrete illustrations; the conclusions are the result of authentic and accurate data; they are not the result of abstract theorizing or of academic study; they are facts. In a great many occupations a man can accomplish as much useful work in a year by working eight hours per day as he can if he works twelve hours every day. This is different from saying that he can do as much in eight hours as in twelve; the point is that fatigue is cumulative; the human machine becomes sluggish. The unfatigued worker does better work and faster work, and if there is a definite number of machines to be operated fewer men are required if they are alert and unfatigued. The result is greater production per man per hour. From every point of view twelve hours is too much time for any man to devote strictly to the performance of his daily work. Provided the work is of such a character as to demand constant attention and application of either mental or physical effort, the average man cannot long continue to do himself justice when spending half his time at his task. An exception might be made for the work of an attendant in a power-house whose duty largely is to be on hand in an emergency; but even if a man in such a position can fulfill the requirements with maximum efficiency for twelve hours per day he is necessarily neglecting definite obligations to his family, and, we venture to add, some perhaps less definite obligations to his own spiritual being and therefore to society at large. In so far as mining and its allied industries are concerned the eight-hour question is virtually a dead issue; except for isolated exceptions, eight hours is the standard maximum for a day's labor, whether it be done by daylight only or on rotating shifts in continuous operations. Doubtless the growth of labor-unions and the consequent persistent pressure on the part of employees was the most important factor in bringing about the change, yet it is safe to say that not one employer in a thousand would revert to a twelve-hour basis; and the reason is not his virtuous desire to be philanthropic, but rather the definite appreciation of the fact that he gets larger production and a better product for each dollar

invested in labor than he could possibly get with a twelve-hour day. But if eight is better than twelve, may not six be better than eight? The more radical labor leaders are clamoring for it; ultra-conservative employers hold up their hands in horror; and the thoughtful employers and efficiency engineers are seeking an answer based on fact. The traditional theory that the day naturally divides itself into three equal periods, one for work, one for recreation, and one for sleep, serves an excellent purpose in that it is an easy and convenient subdivision of time, but it is scarcely scientific. Mr. Emerson declares that he favors four equal periods, rather than three, which would mean a six-hour shift. Lord Leverhulme, who not many years ago was plain Mr. William H. Lever, successful manufacturer of soap, has written a book, 'The Six-Hour Day'. The conclusions that he has reached are based on actual experience in his own large plants at Port Sunlight, a remarkable industrial town in Great Britain, which is the pride of Lord Leverhulme's life and incidentally the home of Sunlight soap, a product that is known around the world. He is a man of acute intelligence and broad experience; he is a theorist, but a practical theorist; he does not presume to say that the six-hour day can be introduced immediately in every industry or under all circumstances, but he does show how it has worked to the advantage of everyone concerned in the enterprise that he directs. Those who oppose any consideration of a six-hour day for the man whose work is manual, or at least routine, declare that wage-earners already have too much idle time on their hands and that this breeds discontent. Perhaps there is truth in the statement; if so, there is something vitally wrong in our social system. Every human being should be able to appreciate comfort, a reasonable amount of leisure, an opportunity to participate in some of the more serious affairs of life outside the winning of his bread, and a chance to play. It is argued that many employers and executives work ten and twelve or even more hours, but if their day is analyzed it is found generally that a large part of their time is devoted to interviews during which they come in contact with new personalities and new ideas. This is very different from the constant application to repetitive performance of a routine task, even though the work may be neither disagreeable nor grueling. There is no question but that if every man and woman in the United States were to devote four hours each day to energetic and effective work, of the kind for which he was best suited, production of every kind would far exceed the need. The trouble is that most work is ineffective; it is inefficient; it is wasteful. But we are acquiring efficiency. In the household, in the office, in the factory, on the farm, and in the mine effort is being conserved. Great strides in the introduction and improvement of machinery have resulted in a remarkable saving of human energy heretofore wasted. Perhaps some day we shall have a universal six-hour day; it may come through systematic and sympathetic co-operation, but never as a result of impracticable and visionary Socialism.

DISCUSSION



Alaska Gold Mines Co.

The Editor:

Sir—In your editorial of December 25 you seemed to support the policy of this company in continuing to run its plant in spite of a heavy operating loss and a hopeless mine. Many important reasons incline me to take the opposite view and to condemn unsparingly a policy that can only mean the complete ruin of the bondholders if persisted in.

As can be ascertained from any corporation directory, the Alaska Gold Mines Co. has a Maine charter and was organized in 1912 to acquire the Alaska Gastineau Mining Co. The mining ground, with a small mill and slight underground development, had been purchased by the latter company for three millions from the original promoters, so that all the later investment above this sum represents the cost of the new 6000-ton mill and power-plants plus the equipment and development of the mine itself. The Alaska Gold Mines Co. has issued, all at par, I believe, \$3,000,000 of mortgage bonds and \$7,500,000 of stock, or a total of \$10,500,000 of securities. Subtracting from this last sum the cost of the mine, we have \$7,500,000 as the recent capital expenditure, of which \$3,000,000 was raised by two bond-issues of \$1,500,000 each in March 1915 and March 1916.

From March 1, 1915, to January 1, 1918, the company paid the bond-coupons as they became due, but its "operating profit" failed to cover this interest completely during the last quarter of 1917, and evidently it never attempted to write off any sum at all for depreciation of plant during this brief solvent period. Since 1917 even the operating profit has been a minus quantity, and the bondholders have looked on helplessly while the company officials are wearing out their vast investment, in power, mining, and milling machinery, as rapidly as it can be done by a daily struggle to extract and treat 4000 or 5000 tons of hard rock from an Alaskan mountain.

In late 1917 it was given out by the directors—perhaps in good faith—that the ore was being extracted from a lean zone and that the then gross value, of \$1 or so per ton, would soon change for the better as the mine advanced into the regular ore-zone. However, the contrary has proved to be the case, and instead of dollar ore they are now treating 85-cent ore or even worse. As a representative of some bondholders, I first protested against this operating policy in June 1918, addressing myself to Charles Hayden, the company's president, and was rewarded by two courteous letters from B. L. Thane, the managing director, in which I was assured that arrange-

ments were being made to sell the power-plants to a local wood-pulp company and that an active search had already been in progress for two years through Hayden, Stone & Co. to find a new mine on which the company's mining and milling equipment could be utilized—a search that had been conducted with energy and extreme caution and, while still unsuccessful, might be expected to locate a winner almost any day. Relying on these sensible promises, I waited patiently, during the balance of 1918 and all of 1919, for some of them to materialize, but as the reckless operating policy still continued with constantly increasing quarterly deficits, I again wrote to Mr. Stone in January of last year.

This time I am answered by E. N. Skinner, as mining engineer for the company, in another courteous letter. But now there are no definite optimistic projects announced either power-plant sales or expected new mines. Instead, Mr. Skinner remarks:

"In this particular case all machinery and equipment that could possibly be moved and sold would not bring a very large percentage of the bond-issue, even if it were possible to receive factory prices for it where it stands, and furthermore, it is expensive to dismantle and prepare for shipment elsewhere.

"Referring to your inquiry about moving the plant to some other mine, the company would of course like to do that if they could find the suitable mine, but as yet they have not been able to do so."

As the three-million dollar bond-issue represents only 40% of the total cash investment in equipment, it is evident that originally the movable machinery alone must have cost nearly, if not quite, all of the bond-issue when one considers the vast quantity required for a capacity of 6000 tons daily by the mining and milling system in vogue. In the tidewater location enjoyed by this mine, its machinery can be dismantled and put on board ship for a small fraction of its value; and it is then ready to be transported to another property, on or near tidewater, in any part of the world at a moderate cost.

Regarding the suicidal operating policy pursued since 1917, Mr. Skinner remarks:

"You ask us to explain as to why operations are being continued, when the mine is being run at a loss, with the result of rendering the plant worthless from wear. As an engineer, you will appreciate that it would not conserve the assets very much to shut down the plants and let them go to ruin in idleness if there is any prospect whatever of keeping them going. If they were shut down, they would be an expense to patrol and guard against fire, etc., and it is well known that a plant of this

kind deteriorates more rapidly when idle than when in use; because when in use it has to be constantly maintained in operating condition."

On the contrary, my experience "as an engineer" renders me quite unable to appreciate Mr. Skinner's point of view. I have preserved sheltered machinery many years, as good as new, by the simple device of covering all unpainted iron parts with thick grease, and have seen other machinery exposed outdoors for many years without harm by taking the precaution to locate it, properly, on a dry foundation, and to re-paint it occasionally. In assuming that machinery can only be kept in good condition by running it constantly, Mr. Skinner evidently confuses hardware with flesh and blood, a gold mill with a traveling menagerie. He goes further in mysticism than even the Monists, for while the latter insist that every particle of inorganic matter is endowed with a soul, I have never heard that they considered that its health could only be maintained by regular and strenuous physical exercise.

The search of Hayden, Stone & Co. for a new mine, as described by Mr. Thane, must have indeed been "cautious", since it has been conducted four years without tangible results. But why this firm should be exclusively relied on to find a new mine for the company, Mr. Thane did not explain, nor does he give any reason for believing that they would turn over a good mine even if they happened to locate one. From the standpoint of mining promoters is not the Alaska G. M. Co. a 'has been'; and, as such, must not any attempt to revive its fortunes appear as futile as would the re-filling of a punched egg-shell or the restoration of a squeezed lemon?

Formerly I labored under the delusion that the management of any enterprise that defaulted the payment of its bond-coupons could be taken over by its bondholders; but to accomplish this the bondholders must get together for legal action, and this is no easy matter in a State like New York, where the company officials are allowed to keep secret the list of bondholders. I was informed by my bankers in New York that the only practical way for a bondholder of the Alaska Gold to proceed would be an expensive course of newspaper advertising, in order to ascertain the names of his fellow-sufferers from mine-wrecking management. Such a remedy being financially impracticable for any small bondholder, there is nothing for him to do but to take his punishment, as the professional promoters very well know.

Some time ago I had occasion to examine a mine in eastern Mexico on which a cross-cut adit had been run 150 metres, and then abandoned while still far from the old vein. At first I believed that the adit proved that the vein must have been considered valuable in its upper workings, but this belief merely indicated my ignorance of Mexican psychology. As I afterward ascertained, the main object of the adit had not been to find ore but to enable the local foreman to continue his profiteering at the expense of the peons, who were paid by an absentee owner. Similarly, the real reason why Alaska Gold has continued its vast operations for four years at the bond-

holders' expense may some day come to light. As you say, it "has no object in keeping its underground workings in condition for future mining". And as it has no other property to which it can migrate, it has no excuse "for continuing to mine in spite of an operating deficit with the desire to keep intact as far as possible the essential parts of the working organization". One might guess that the promoters had filled the Alaska Gold management with their friends or relatives and that operations were being prolonged for their benefit; but while such a guess might be plausible in Mexico, it would hardly be so in the United States, especially in view of the active demand for mining men that has existed since 1916. Indeed, the problem seems to be as insoluble as that of 'The Lady and the Tiger', which perplexed my youth.

ROBERT BRUCE BRINSMADE.

Ixmiquilpan, Mexico, January 10.

The Broad Lode Hypothesis

The Editor:

Sir—To anyone who has followed closely the subject of 'Apex Litigation' the mention of this subject must induce discussion; therefore I ask your indulgence for space to discuss a few points covered in the contribution signed A. G. Ologist in your issue of January 15.

Having run the gauntlet of cross-examination by many a shrewd lawyer, whose chief desire seemed to be to get a contradiction out of a witness, rather than an exact statement of the truth about physical facts, it has been impressed upon me that partisan statements on the part of a witness in an apex case is the worst kind of evidence and least likely to convince the Court. If it is ever possible to administer justice in these cases it must be by means of skilled engineers, employed by the Court, not by the litigants. In that case the matter of a strict definition of lode or vein would not matter so much. In fact, I believe that the attempt to frame an all embracing definition is practically hopeless and will be modified and probably materially changed, each time that a judge renders a new decision in an apex case.

The definition proposed is a good one but not unassailable, due to the fact that the words "sufficiently mineralized to warrant mining operations with reasonable expectation of finding ore" will be dependent on the personal equation. That which inspires reasonable expectation in one man will be looked upon pessimistically, if not with disdain, by another. It is fortunate that hope springs eternal in the breast of the miner, otherwise we would surely have no prospecting and but little persistent development, except in those rare cases in which pay-ore is continuous and uniformly of a good marketable grade.

My own idea, and this is not the first time I have expressed it, is that the only real cure for the evil of apex litigation will be the adoption of the 'square' location, and the sooner we come to that conclusion and make the change, the better we shall be regarded by our posterity

engaged in mining. Mining is hazardous enough without being obliged to maintain one's rights in courts where, as Mr. Locke says truly "prejudice jumps to the front" and it is a fair prediction that all the definitions in the world will not serve the desired purpose of making the apex law so simple that "he who runs may read".

San Francisco, January 19.

F. L. SIZER.

The Refining of Oil-Shale

The Editor:

Sir—In July 1919, in my letter to you on the subject of oil-shale and low-temperature distillation, I said that methods which involved mass carbonization were obsolete.

Work carried on for over three months recently on a working scale has proved the correctness of my statement and has thrown much new light on the little-understood art of distilling and refining solid hydro-carbons. The process and retort adopted by the Carbonization Company avoid treating a compact mass of material into which heat has to be introduced at a high cost of B.t.u. By treating each particle in an unconfined or free condition, by cascading it through the heat medium, the result has been rapid heating of the particles and the easy evolution of the gaseous product. By being removed quickly the particles are saved degradation. These conditions, I venture to think, are two (among others) of the most essential to success and mean that a large throughput can be obtained at a minimum expense of heat while the product is in the best condition.

But the mechanics calling for the necessity of continuous operation, the arrangements to heat the material as above, successively, in zones, and up to temperatures of 1400°F. with the proper care of the gas and waste residue, as well as treating the material in a closed gas circuit, involved considerable and careful working out. However, in a simple horizontal retort, revolving at whatever speed is best, these requirements have been filled, not merely theoretically but in practice. The procedure is almost fool-proof, so flexible that it can be adjusted to any conditions likely to be required, utilizing 10% less heat than the old vertical methods, and allowing the operator to exercise his ability as a distillery artist to the limit. Apropos of which we have demonstrated his fact, which should help any engineers attempting low-temperature distillation, that every shale or lignite or coal has striking idiosyncrasies or characteristics peculiar to itself, which it is necessary to ascertain first in order to treat them properly. By way of example: of two shales apparently the same, one gave up 90% of its contents in 18 minutes at 600°F. and the other yielded 10% in 30 minutes, then stopped evolution until 920° was reached, when it took 70 minutes to get another 25% and so on in most cases; clearly indicating that it is necessary to build or adjust the retort to suit the character of the hydrocarbons, to say nothing of the nitrogen. Nor will laboratory methods, or any small retorts we now, do more than indicate to a minor degree the results

to be obtained in actual practice; laboratory results are usually maximum in quantity and poorer in quality than working results.

I am writing you this because we now have the actual proof of the correctness of the somewhat startling assumption about mass carbonization, but, inasmuch as we have accomplished today in an average of 100 minutes what usually takes 24 hours, I am sure the fact will be helpful to the industry and if for no other reason than that large tonnages that are so essential are easily dealt with, in other words, the old 5-ton retorts can be replaced by 50-ton units or larger and at far less cost per ton.

I have heard it said that it is quite easy to treat shale or any non-intumescens material. Perhaps it is, but no method of low-temperature distillation of intumescens shales (and there are some), bituminous coals, etc., has, so far as we know, on either side of the Atlantic, been yet accepted as an unmitigated success. Recent results, however, indicate with a considerable degree of certainty that a practical method of handling intumescens materials by low-temperature methods is within sight and without entirely disregarding the nitrogen content.

New York, January 2.

ARTHUR L. PEARSE.

Mining in Dutch Guiana

The Editor:

Sir—In your issue of January 1, I notice an article from a correspondent on mining in Dutch Guiana. Mr. Van Wageningen asks why it is that this country, where he states that nearly everything is favorable for successful gold mining, is neglected, and why Siberia is more attractive. He then asks if the reason is political, economical, or merely psychological.

Having been in both countries, I beg to differ with several of his statements, and offer the opinion that the main drawback to Dutch Guiana as a gold-mining region is economical. Perhaps he can tell me how to mine a two-foot vein averaging around \$2.50 in gold per ton, almost anywhere and make a commercially attractive profit. I do not know how to do it! And the long string of failures on exhibition down there rather bears me out.

Granted that the field is reasonably near the United States: is orderly politically; fairly well connected with the rest of the world by steamships and cables; it is not what I call healthy nor particularly attractive as an abode. There is plenty of malaria, as in all swampy tropical countries. Mining supplies can be bought there, largely imported, and the usual tropical foods are grown, but no one as yet has demonstrated any remarkable commercial gold deposits, unless the river Lawa placer operations can be so termed.

Labor is undoubtedly cheap, but it is not worth any more than you pay for it, and not to be compared with the better grade of Mexican labor in either efficiency or ability. And how could it be so, with no large underground mining operations in existence?

While there is no water to fight on the surface, except something like 80 inches of rainfall per year (!), how

long would that statement be true when some deep shafts were sunk and extensive underground workings opened up?

Regarding the Western mining man who has produced \$135,000 in gold, how much did that cost him, and what profit can he show for his heart-breaking labors? And just how many millions of tons of \$3.37 ore has he in sight, and what are the width of his veins?

Mining people will go to Dutch Guiana a lot quicker than they will go to Siberia these days, as soon as you bring real proof that large commercial propositions are available, but they will not go to mine erratic one and two foot veins of \$2.50 ore that are liable to give out at any moment. Those are 'one man' propositions.

New York, January 10.

A. R. ROGERS.

The Single-Jack in Western Australia

The Editor:

Sir—In your issue of December 18 Mr. West states that Mr. Hoover was the man who introduced the single-jack at Lawler's, W. A. For his information I may say that Paddy Lawler, Billy Gibson, Moses, Jack Wallace, and myself all used single-jacks at Lawler's before Hoover appeared on the eastern goldfields of W. A.; we were the discoverers of Lawler's and the locators of the Great Eastern, the True Blue, Donegal, and Lawler's Reward, comprising the East Murchison, sold to Bewick, Moring & Co. through Mr. Dunstond and experted by George Armstrong. Hoover came a little later. Mr. West must have been an energetic young man to have peaked into every hole in Kalgoorlie in 1897; there was quite a number there at that time. Pat Hannan, the discoverer of Kalgoorlie, was a single-jacker on Parker's Range before he came to Coolgardie. Arthur Bailey and Bill Ford, the discoverers of Coolgardie, were both single-jackers in Queensland and other camps in the North-West; in fact, the single-jack was used from Gympie to Mount Morgan and from Mount Morgan to Kimberley and from Kimberley to Southern Cross before either Hoover or West saw the Antipodes; it was known as a 'gympie', taking its name from the place it was first introduced, in Australia. So much fuss about nothing. If you meet Mr. West, you will be able to tell him who first used the single-jack; it was the prospector. When you consider the nature of the country and the vast distances from the sources of supply, the reason is obvious.

ERNEST MORRIS.

Tombstone, Arizona, December 28, 1920.

[This discussion is now closed.—EDITOR.]

Sampling in a Mill

The Editor:

Sir—The following may be of interest to Messrs. Eye and Dodd, authors of the recent article on 'Milling Practice at the Benguet Consolidated Mine'.

In their interesting article they mention that "sam-

pling the discharge of the mortars with correction for the estimated amount of value dissolved in stamping—gave results not close enough to be dependable".

The head sample at the Rochester Silver Corporation mill is arrived at by the following procedure:

The ore passes through 10 stamps to Dorr classifiers and tube-mills in closed circuit. At the discharge of each classifier a pulp sample is taken over a period of 24 hours, at half-hour intervals. The entire sample is saved. After being mixed well, the following samples are removed from the pulp:

One for moisture to determine the ratio of solution to ore.

One for solution value.

One for washed-pulp value.

A sample of the solution entering the batteries is taken over a 24-hour period.

The calculation is:

Let a be assay-value of battery solution.

b be assay-value of classifier solution

c be assay-value of washed pulp.

d be ratio of solution to ore in sample.

then $(b-a)d + c =$ heads.

In the five years that this sample has been used it has been 6% to 8% lower than bullion plus contents of tailing.

The following factors probably affect the accuracy of this method:

The usual inaccuracy of sampling by mill-men.

Moisture in the ore from the mine.

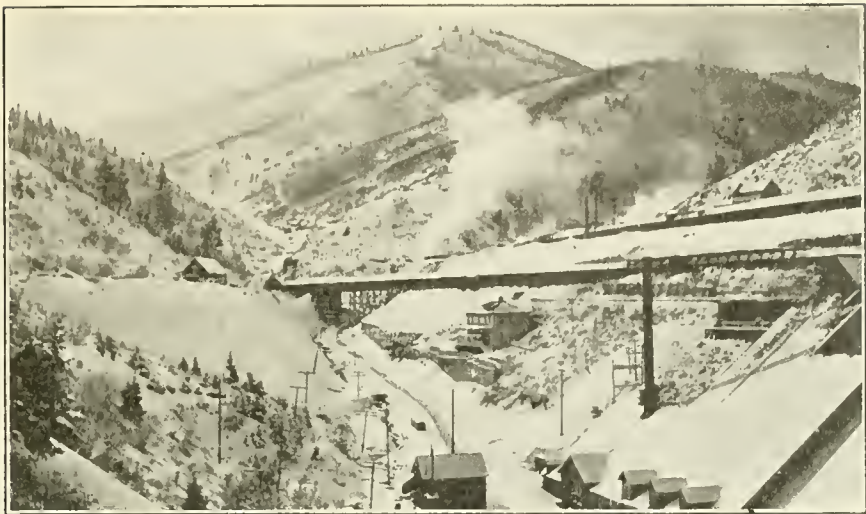
Tube-mill pebble tonnage.

Evaporation.

W. G. EMMINGER.

Rochester, Nevada, December 15, 1920.

LEAD PRODUCTION during 1920 is summarized as follows: The production of primary domestic de-silverized lead was about 215,000 tons, of soft lead 189,000, and of de-silverized soft lead 70,000 tons, making a total output from domestic ores of about 474,000 tons of refined lead, compared with 424,433 tons in 1919, made up of 208,751 tons of de-silverized lead, 147,744 tons of soft lead, and 67,938 tons of de-silverized soft lead. The output of lead smelted and refined from foreign ore and bullion was about 64,000 tons, compared with 57,787 tons in 1919. The total lead smelted or refined in the United States was thus about 538,000 tons, compared with 482,220 tons in 1919. The production of antimonial lead was nearly 12,000 tons, against 13,874 tons in 1919. The exports of lead of foreign origin were about 22,500 tons and of lead of domestic origin 3000 tons, compared with 42,912 tons and 10,510 tons, respectively, in 1919, a decline of nearly 28,000 tons in the total exports. The imports of refined pig-lead, which for the years 1916 to 1919 inclusive had been a little over 5000 tons per year, jumped to about 34,000 tons. Up to the end of November, 9425 tons of refined lead had come in from Mexico, 1680 tons from France, and 12,978 tons from England. Some trans-shipped Spanish and Australian lead is included in these quantities.—U. S. Geological Survey.



DALY-JUDGE MINE, PARK CITY, UTAH

Metallurgical Operations of the Judge Mining & Smelting Company

By Arthur B. Parsons

The Judge Mining & Smelting Co. is a consolidation of the Snake Creek Mining & Tunnel Co. and the old Daly-Judge company. It owns a modern 500-ton concentrator situated near the portal of the principal adit of the mine and an electrolytic-zinc plant with a capacity of 10 tons of high-grade zinc ingots per day. The mine and mill are just above the town of Park City, Utah, whereas the electrolytic plant is situated on a railroad spur some distance below the town, and about 2½ miles from the concentrator. Recently the same interests have acquired control of the Daly, Daly West, and Park-Utah mines, and arrangements have been made whereby all are operated under a single management. The workings of the Daly and Daly West mines are connected with those of the Judge, and all the milling ore at the present time is hauled 1½ miles or more through the Judge adit to the concentrator. Ore of shipping grade is routed through No. 1 drain tunnel directly to the railway loading-station.

The ores are both carbonate and sulphide, but the principal valuable minerals are galena, sphalerite, and pyrite. Only small amounts of copper and gold are present, but the silver content is important, ranging from 10 to 30 oz. per ton. The gangue is silicious, being principally quartzite. Two classes of ore are mined; one for direct shipment to the smelter in the Salt Lake valley and the other for local treatment. Typical average assays of the two grades follow:

	Silver, oz.	Gold, oz.	Lead, %	Copper, %	Zinc, %	Iron, %
Shipping-ore	30.0	0.025	16.5	1.25	8.25	7.75
Concentrating-ore	14.5	0.02	10.5	0.75	12.5	5.0

Two concentrates are made in the mill, namely, a lead

concentrate, reasonably low in zinc, which is shipped to the smelter, and a zinc concentrate, containing considerable lead, for roasting, leaching, and precipitating at the electrolytic plant. The ratio of concentration for lead is 4.5:1; for combined lead and zinc concentrate it is 3:1. Typical analyses of these two concentrates follow:

	Silver, oz.	Gold, oz.	Lead, %	Copper, %	Zinc, %	Iron, %
Lead concentrate	24.5	0.04	31.5	0.6	8.9	19.5
Zinc concentrate	15.0	0.02	4.5	..	39.6	6.5

THE CONCENTRATOR. The feature of the concentration is the separation of the intimately mixed lead and zinc minerals. Jigs, tables, and flotation-cells are used in the process, in rather intricate combination, the flow-sheet being complicated because of the re-treatment of flotation products on Wilfley tables. Omitting many of the details, the treatment may be described briefly as follows: After being crushed in two sets of 15 by 36-in. Allis-Chalmers slow-speed rolls, with an intermediate trommel, the ore is sized in a series of trommels with 3, 4, and 8-mesh screens preparatory to concentration in Harz jigs, equipped with Missouri plungers. The undersize from the last trommel is classified hydraulically for finer jigging. All these jigs make a finished lead concentrate, a middling, and a tailing to be discarded. The middling from the primary jigs is re-ground in a 4½ by 6-ft. Marcy ball-mill fed with 4-in. manganoid steel balls, and a product passing an 8-mesh trommel, but oversize on a 22-mesh Callow screen, is separated to feed two zinc-jigs. These make a product ready for the electrolytic plant. Instead of the drag, or rake-classifier, generally used, a trommel with ½-in. screen, in closed circuit with the

Marcy mill, gives large capacity and minimizes the quantity of slime produced in grinding.

Richards Janney classifiers and a Richards free-settling classifier are used to prepare the undersize from the 8 mesh Callow screens for Wilfley tables. The usual intermittent discharge from the Richards Janney classifiers has been discontinued with a view to providing a more uniform table-feed; so operated, it has given equally good results as to sizing. The tables make both a lead and a zinc concentrate, a middling for re-dressing, and a tailing. The slime overflowing from the classifiers and that from sundry Callow cones is collected in a three-deck 36-ft. Dorr tank where it is thickened preliminary to flotation treatment. The plow-arms are rotated by a 5-hp. individual motor connected through a D. O. James speed-reducer by means of which 1800 revolutions is diminished to 64.

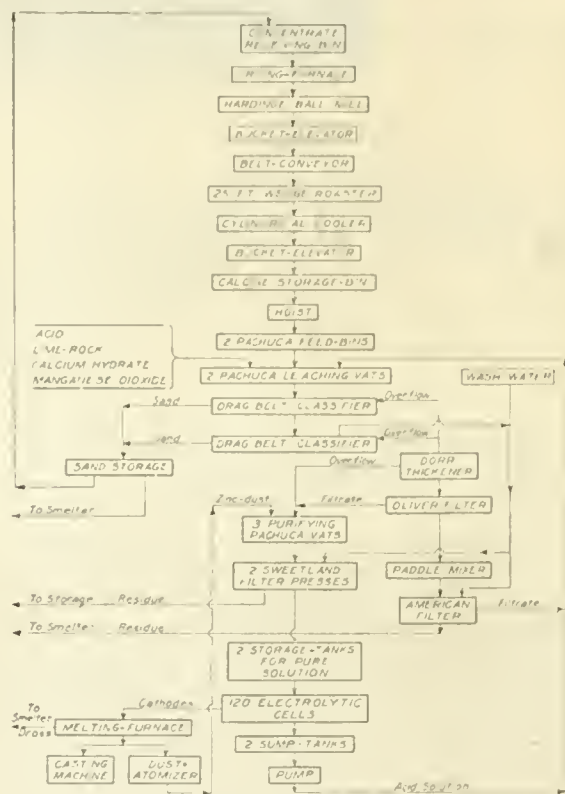
FLOTATION. Pneumatic cells are used. No differential or preferential flotation is attempted, as experimental work has not been sufficiently encouraging to warrant the attempt, especially in view of the fact that the lead in the zinc concentrate is recovered from the leached residue from the electrolytic plant. The status of flotation litigation is a deterrent to the use of the process. Indeed, I am told that the company may discontinue the use of flotation entirely and substitute another method of slime treatment. Ninety per cent of the flotation concentrate is re-treated on Wilfley tables where the zinc and lead are separated. Such flotation concentrate as is not tabled, and the overflow from the drags is pumped to a small tank, equipped with Dorr thickening-rakes, the underflow from which goes to an 8-ft. Portland filter with a 3-ft. face. The filter dewateres the concentrated slime to about 25% moisture. The jig and table concentrates are dewatered by means of belt-drags of various sizes and with slopes of varying inclination, the maximum being 45°. The rakes are composed of angle-iron bent so as to travel in a vertical position, and are fitted with replaceable shoes, consisting of flat strips that are bolted to the projecting part of the angle. These shoes have four or five notches $\frac{1}{4}$ in. wide in the edge next the plane upon which they drag, and alternate ones are displaced sidewise in one direction a distance of half an inch. These two details of construction are uncommon; the purpose is to assist the flow of draining water and thereby effect a more complete dewatering of the concentrate, the moisture in the finished product ranging from 12 to 16%.

The total recovery in the concentrator is not exceptionally high, especially with respect to the zinc, but an adequate supply of concentrate for the electrolytic plant is made, and, for various reasons, it is deemed inadvisable to make any radical alteration in the scheme of treatment at the present time.

The railroad does not reach the mine and concentrator; accordingly the concentrates are hauled by team either to Park City, to be loaded on railway-cars, or beyond to the receiving-bins at the zinc-plant. The operations there will now be described.

TREATMENT OF ZINC CONCENTRATE. The process consists of a number of consecutive operations, namely, drying and grinding the concentrate, roasting, leaching by agitation, filtration, purification of the solution, clarifying, electrolytic precipitation of the zinc, and melting and casting into bars for shipment. The sequence of treatment is indicated on the accompanying flow-sheet.

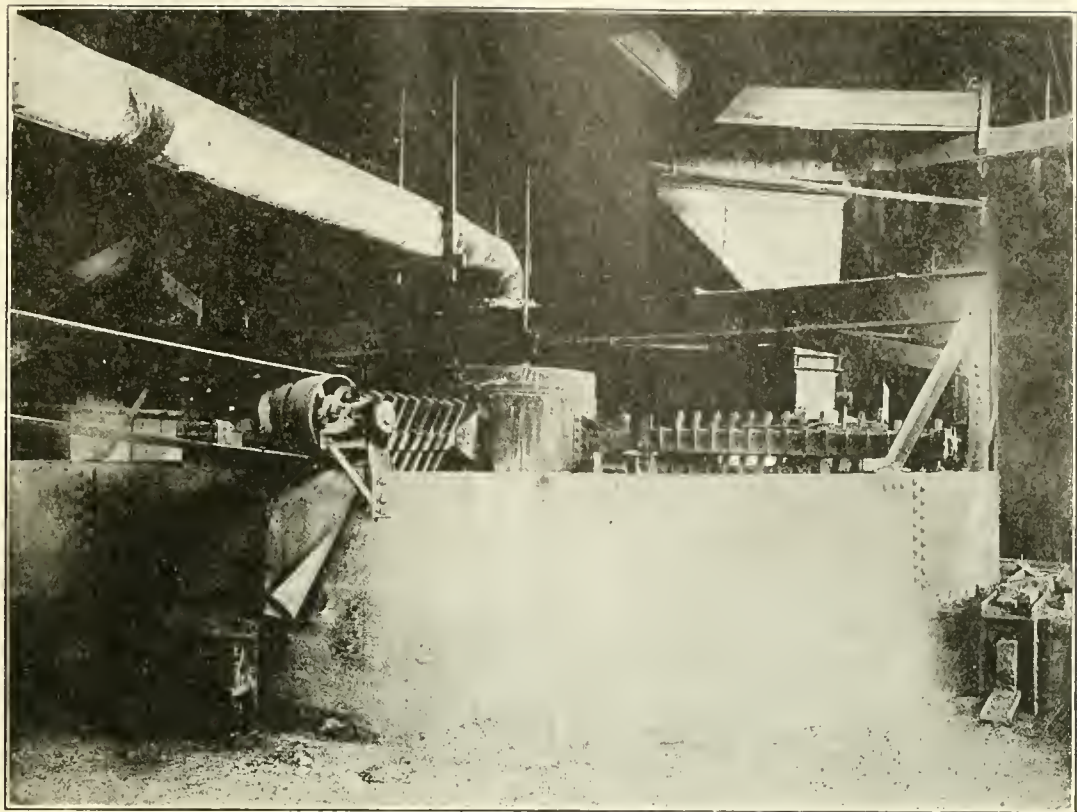
Until recently the procedure had been to put only the jig-concentrate through the dryer and ball-mill, while the table and flotation products were handled separately up to the point where they were charged in raw form on the top, or drying, hearth of the roaster. In October, when I was at the plant, all the concentrate was being mixed in the receiving-bin that feeds the dryer. The



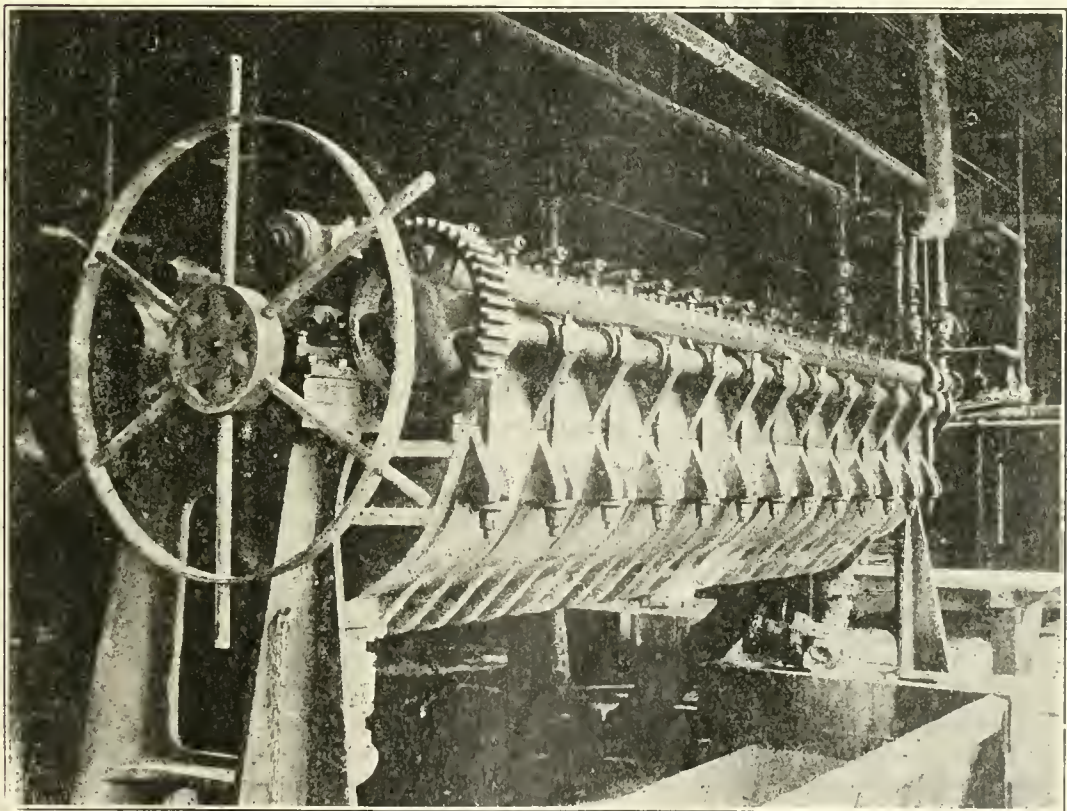
FLOW-SHEET OF ZINC REFINERY

additional grinding of the table-product, 20% of which is plus 60-mesh, improves the roasting and likewise the extraction in the leaching Pachuca. The fineness of the table-concentrate produced will govern future practice in this regard. There is also mixed with the raw concentrate approximately 3% by weight of the coarse leached residue. There is still 20% zinc in this product, some of which is freed by further grinding and a second leaching; but the principal virtue is in diluting the sulphide to some extent, thereby hindering the tendency of the calcine in the roaster to fuse, as well as keeping the charge cool and porous.

ROASTING. A belt-conveyor carries the mixture to the hopper feeding a revolving coal-fired dryer in which the moisture content is reduced from 12 to 15% down to 1 or 2%, previous to being ground in a Hardinge ball-mill. While no attempt is made to screen and return any over-



UPPER HEARTH OF ROASTER SHOWING BELT-FEEDER



SWEETLAND FILTER WITH WIDE-LEAF SPACING, AS USED IN THE ZINC PLANT

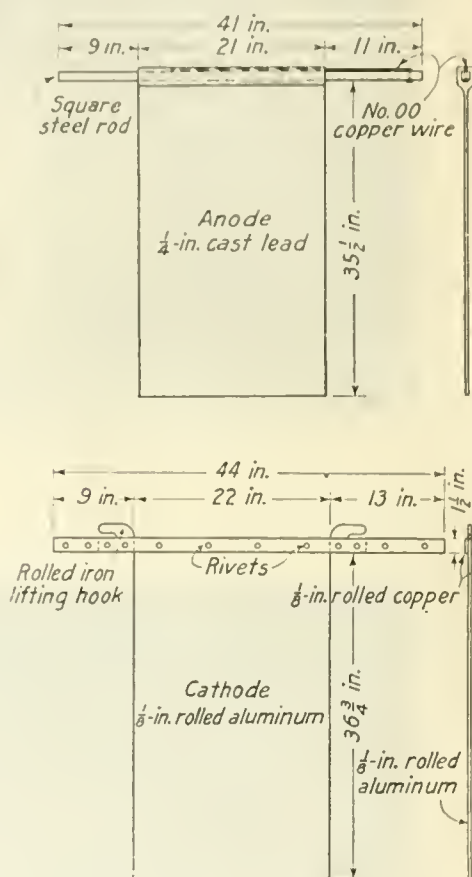
size to this ball mill, practically all the product will pass a 60-mesh screen. The ground material is elevated to a bin from which it is fed by belt conveyor to the drying hearth of a 25-ft. Wedge roaster, making one revolution in from five to eight minutes. This rate can be altered by means of a Reeves variable speed transmission, but since the purpose is to approach a dead roast as nearly as possible the furnace has always been operated at 1 r.p.m. A Wilson Macaulay pyrometer, the recording mechanism of which may be connected with any hearth by means of a series of wires connected at a central switch box, is read every four hours, typical readings under normal condition being as follows:

Hearth	Degrees Centigrade
1 (air drying)	260
2	400
3	500
4	550
5	650
6	660
7	450

While the ideal is an isothermal roast at 650°, in actual operation the second, fifth, and sixth floors are hotter than the others, and the furnace-arms on these hearths are accordingly cooled with water, instead of air. Cooling-air is circulated through the arms on the remaining hearths by means of a No. 9 centrifugal fan made by the Buffalo Forge Co. With the usual feed, 14 or 15 hours is consumed in the passage of a given particle of ore through the furnace, while the sulphur content of the charge is reduced from approximately 30% to 2% of insoluble, or 'sulphide', sulphur. The roaster is fired with coal, the heat entering the furnace at the sixth hearth, thus permitting the seventh or bottom hearth to serve as a cooler, as indicated in the table of hearth-temperatures. The calcine then passes through a 6-in. iron pipe to a 5 by 16-ft. cylindrical cooler. This consists of an iron tube, with axial feed and discharge-openings, revolving in a bath of circulating water. Spiral screws convey the calcine through the dryer.

LEACHING. The cooled material is conveyed to a 400-ton storage-bin and is thence hoisted to three separate bins that in turn feed either of three 22 by 10-ft. Pachuca agitators in which the leaching takes place. The central lift-column of these agitators is square, made of fitted two-inch plank. At vertical intervals of two feet are collars of 2 by 4-in. material fastened together with wooden pins that tighten as they are driven. This column was designed at the plant; it is cheap, serviceable, and has proved durable in spite of severe service. A large volume of air is used for agitation, and it is necessary to put a horizontal baffle over the top of the lift-column to prevent violent splashing. The term 'leaching' is perhaps not accurately applied to the operation, and is misleading in so far as there is no percolation. The solution and calcine are agitated and the pulp dewatered by an Oliver filter. The process is intermittent, the period of a cycle being six to eight hours. First, 33 tons of electrolyte that has passed through the cells is run into the agitator from the storage-vat to which it is periodically pumped from the sump below. Into this solution, which

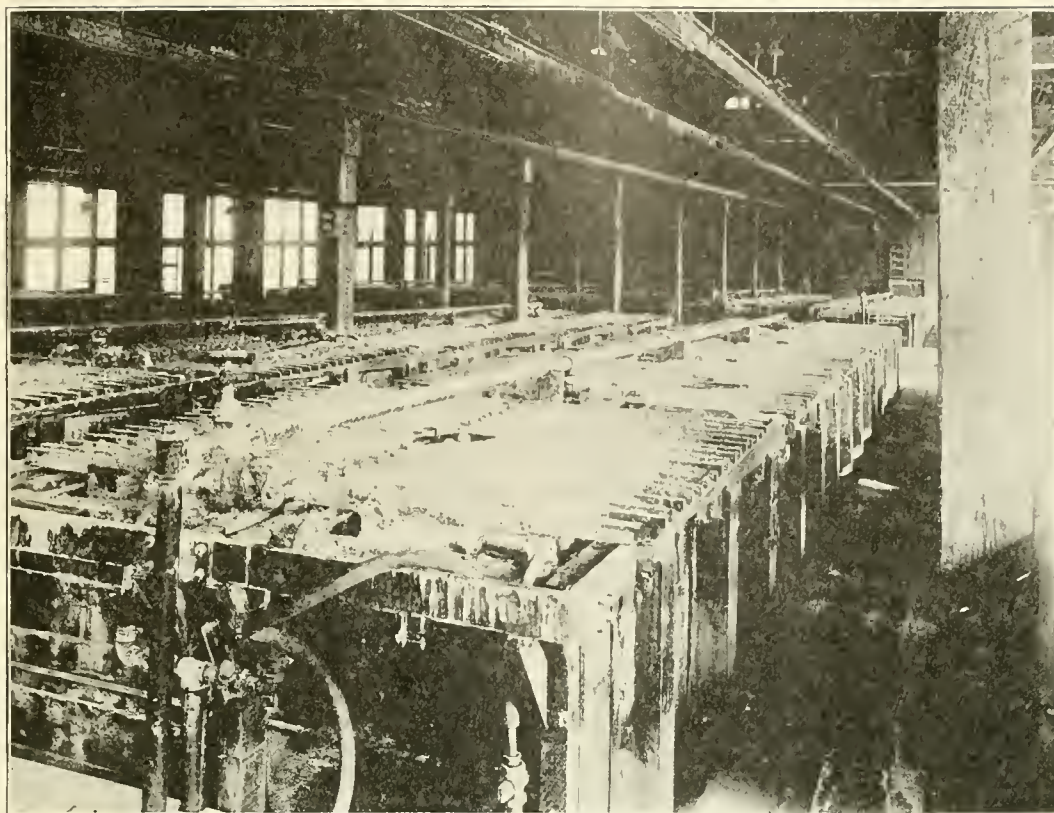
should contain 45 gm. of sulphuric acid per litre, is introduced sufficient calcine to consume all but a small proportion of the free acid; less than one gramme, as determined by titration, generally remains after the addition and agitation of approximately five tons of calcine. To finally neutralize, 100 lb. of crushed limestone for each gramme-per litre of free acid is added, together with 125 lb. of calcium hydrate. Most of the silicic acid may have been dissolved during the acid treatment is precipitated in gelatinous form at this stage of the process, although some further removal is accomplished in the subsequent purification of the filtrate with zinc-dust. It is then only necessary to oxidize the ferrous sulphate to



DETAILS OF ANODE AND CATHODE

ferrie sulphate in order to precipitate the iron and antimony.

This is effected partly by the air introduced in agitation and partly by the addition of manganese di-oxide, of which about 15 lb. per charge is required. The operation is similar to the method of removing arsenic at the Anaconda Copper Co.'s plant at Great Falls. There is a minute quantity of arsenic in the Judge ore, but it disappears in the course of roasting, and only antimony remains to be precipitated. The original plan was to oxidize with potassium permanganate, but inability to secure an adequate supply of this reagent resulted in the selection of manganese di-oxide as a substitute. It is not satisfactory, but, being a by-product of the cells, it is always available and serves the purpose. The objection to its use is inferior work in the cells, consequent to in-



ELECTROLYTIC CELLS IN THE ZINC REFINERY

complete purification. This will be mentioned again.

To complete the cycle, the charge is pumped through wooden pipes to a 4-ft. Esperanza drag-classifier, with wooden rakes, where the coarse leached sand is removed with about 18% moisture. Recently a second smaller drag has been installed to wash this sand with water and thus reduce the loss of dissolved zinc by replacement of a part of the rich zinc solution.

FILTERING. The overflow from both drags goes to a 30 by 12-ft. tank fitted with a lead-covered shaft and Dorr rakes of bronze. The pulp, thickened to a consistence of 1:1, water:solid, goes to a specially made 8-ft. Oliver filter. The spokes and rims of the drum are made of wood, the wires and screens are of copper, and the pipes are of lead, while the cover consists of a woolen blanket beneath a special twill-canvas that lasts two months. The copper itself is made of steel plate but is lined with lead. This filter removes only two-thirds of the solution, the cake containing about 50% moisture; to further reduce the loss of zinc sulphate an American continuous disc-filter has lately been installed. The Oliver filter-cake is mixed with water in a locally built paddle-agitator, and pumped to a second Dorr thickener, the thickened pulp from which goes to the American filter. The tank and frames are of redwood and the three 6-ft. discs duplicate the results of the Oliver. The Oliver makes a cake $\frac{3}{4}$ in. thick as against $\frac{1}{4}$ in. for the American, but neither is able to dry to less than 45% moisture. A 14 by 18-in. vacuum-pump, lined with bronze and made by the Doak Gas Engine Works operates both filters through individual wooden receivers, by the dry-vacuum system. Nineteen inches of vacuum is maintained.

Typical analyses of the two residual products are as follows:

	Zinc, %	Copper, %	Lead, %	Silver, oz.
Classifier sand	20.5	0.85	4.8	20.0
American-filter cake	12.8	0.85	7.1	19.5

The figures giving the zinc content indicate the more effectual extraction of the zinc in the finer material. Only 20% of the residue is sand, however, and as mentioned before part of this is returned to the head of the mill for re-treatment.

PURIFICATION. The next step is the purification of the overflow from the thickener and the filtrate from the Oliver filter, that is, the removal of the copper and cadmium together with any remaining antimony and silica before the solution is ready for the electrolytic cells. This is done by treating charges intermittently in any one of three 10 by 15-ft. Pachuca agitators, equipped with lift-columns of wood similar to those in the leaching agitator. Brisk agitation for 30 minutes after the addition of zinc-dust, in the proportion of three pounds of dust per ton of solution, suffices for this purpose. Two grades of zinc-dust are used separately; four-sevenths of the total is zinc coarser than 60-mesh and grading up to 8-mesh, while the remaining three-sevenths has passed 60-mesh. It has been found that the coarse zinc precipitates the copper readily but does not replace the cadmium, and, moreover, that the finer-sized material precipitates the cadmium more efficiently if the copper has already been removed. It is for this reason that the two grades are prepared separately and added successively, although the precise reasons for this behavior are not known. The dust is prepared, in the furnace-room

where the stripped anodes are melted, by a process devised at the plant. Molten zinc is allowed to flow in a small stream, the current of compressed air issuing at a pressure of 100 lb. from a special nozzle made of a one-inch pipe. The zinc is effectually 'atomized'; it is collected in a large galvanized chamber at the hoppers bottom of which is a conveyor, and only requires screening to be ready for use in the purification process.

The precipitate of copper and cadmium is removed by passing the solution through two 3 ft. Sweetland disc filter presses, each having 36 leaves. The copper having been precipitated, and the solution at this stage being neutral, the Sweetland presses are of standard construction, that is, they do not require parts of acid-proof material. They are cleaned daily and give satisfaction. The cake from the Sweetland presses, containing 50% zinc, and approximately 5% each of copper and cadmium, is at present stored pending the perfecting of a method of recovering the metals economically. Experimental work indicates the development of a successful scheme. The clarified solution goes to two storage tanks, each 18 by 21 ft., from which it is drawn as required for the precipitating-cells.

ELECTROLYTIC PRECIPITATION. As originally built, the electrolytic department comprised 120 cells in two groups of 60. Each cell contained twelve aluminum discs, 5 ft. diam., mounted on a slowly rotating shaft, alternating with lead anodes supported independently of the shaft. While it is possible that this arrangement might have proved successful had the original scheme of purification with permanganate been feasible, the revolving discs were replaced after some months of operation by the present stationary equipment with rectangular anodes and cathodes. The detrimental effects of incomplete purification were magnified by the rotating discs and difficulty resulted from warped plates and poor contact of the cathodes. The grade of the zinc was above 99.9%, but the current-efficiency was only 50%, as against 80% now regularly being obtained. Though theoretically good, the discs appear to be too delicate for practical use.

The present plant contains two sections, each composed of 60 cells containing 19 lead anodes and 18 aluminum cathodes. The containing-vats are 7 ft. long, 3 ft. wide, and 4½ ft. deep, arranged in rows of 10, there being six double rows across the width of the room. An aisle 10 ft. wide affords working-space between the double rows. Three of these double rows comprise an electrical unit, while for the purpose of introducing the electrolyte the rows are divided into series or cascades of five cells, there being a difference of three inches between the elevation of successive cells. For convenience, there is also a wide aisle going across the room between the two groups of cascades.

Both anode and cathode bus-bars are on the side of the cells next the working-aisle, the anode bus being inside and ¼ in. lower than the cathode. One end of the anode and cathode supporting-rods rest directly on the copper surface of the bus-bar while the opposite end bears on a wooden strip placed on the inner side of the vat. They

are made of rolled copper, are supported independently of the vats by wooden posts, with heavy glass plate insulators, and taper from a maximum cross-section of 4 by 1½ in. to a minimum of ½ by 1½ in. as the point of minimum current is approached. The tapering dimension is vertical. This saves copper without impairing in any way the serviceability of the bus. Sixty cells are connected in series, the connection being made from the cathode to the anode bus by means of a copper plate, 4 by 7 in. and ¼ in. thick, joined by means of six ½ in. bolts.

The anodes are made of cast-lead sheets, ¼ in. thick, supported at the top by means of a steel rod, one inch square, about which the sheet is wrapped. In order to effect good electrical contact a tinned copper wire, size 00, is burned into the lead as indicated in the accompanying sketch, and carried along the top of the steel bar to a hole near the end. It passes through this hole and is beaded to present a greater surface to the bus-bar. An attempt to make electrical connection by sweating the lead to the steel was a failure.

The construction of the cathodes is likewise shown. These are made of the best obtainable sheet-aluminum ½ in. thick, supported by two 1½ by ½-in. strips of copper, riveted together with the upper edge of the aluminum sheet between them. The two small iron lugs at either side of the aluminum sheet serve as a means for lifting the cathodes from the vat and carrying them to the stripping-floor.

The normal area per cathode exposed to the action of the electrolyte is 68 by 22 in., while the corresponding anode-area is 66 by 21 in., which gives 203.5 and 173.25 sq. ft. as the respective areas for an entire cell.

The practical measure of the results obtained in the cells is the net current-efficiency, that is, the amount of zinc actually precipitated per unit of electric energy as compared with the ideal quantity that should be precipitated. The rate of deposition on the cathode plate theoretically is dependent upon the current-density. There is, however, a continuous re-solution of deposited zinc by the cell-solution that varies with the chemical and physical condition of the electrolyte as well as with that of the zinc itself. The character of the deposit is affected largely by the kind and quantity of impurities remaining in the filtered solution from the leaching plant; in fact, it is fair to say that the essence of the entire process is adequate purification. The compactness of the deposited zinc is, however, affected by the rate of deposition; this in turn has a bearing on the rate of re-solution, and accordingly a standard current-density has been determined that will balance the various factors to the best advantage. Under the conditions in this plant 27 amperes per square foot of cathode has been found to give the best results. Typical analyses of the electrolyte as it enters and as it leaves the cells follow. The figures represent grammes per litre.

	Sulphuric Cad-				Anti-	Manga-
	Zinc	acid	mium	Copper	mony	nese
Influent solution	57	0.2	0.003	0.0006	0.0010	0.415
Effluent solution	20	45.0	Trace	0.0002	0.0009	0.035

These figures call attention to a number of facts: It is

desirable that the effluent solution contain approximately 20 gm. of zinc, for the reason that if the electrolyte is impoverished below that point the cells become 'starved' and the re-dissolving action is accelerated. The same result is found when the free sulphuric acid in the effluent electrolyte exceeds 45 gm. Solution of the strength shown establishes an economical balance and these strengths are maintained by the regulation of the rate of flow through the cells. Normally, solution is added in the first and third cells in the cascade of five, although the pipe-connections enable the introduction of solution at any cell. It is found advisable to flush the cells occasionally, thus increasing the zinc content of the solution in the lower part of the cascade and thereby stimulating electrolysis.

The solution analyses reveal the fact that the cadmium, copper, and manganese are, to a great extent, precipitated in the cells while the antimony remains in the effluent solution. Manganese is one element that does not appear to have any bad effect on electrolysis. While the chemical reactions are not definitely known the actual result of the presence of manganese is an accumulation of manganese di-oxide at the anode surface. At intervals the anodes are removed singly from the vat and the accumulation scraped off, thereby exposing the fresh surface and increasing the current-efficiency. The scrapings are returned for use in the leaching-vats.

On account of the scarcity of water the first unit of the cells was operated without any provision for cooling the electrolyte. The temperature naturally became excessive and the re-solution of zinc increased prohibitively and it was apparent that the electrolyte in the cells must be cooled. To provide for the re-use of the cooling-water an outdoor spray system consisting of 18 vertical nozzles from pipes supported over a concreted pond, 50 by 75 ft., was constructed. This scheme is inexpensive and affords an adequate supply of circulating water to regulate the temperature in the cells even with the limited amount of fresh water obtainable. Each vat is fitted with a coil made of 45 ft. of lead pipe through which the cooling-water passes. A valve for each vat permits the regulation of the temperature of the units independently.

The cathodes are stripped by hand once in 24 hours, nests of six being removed from the vat by means of a one-ton chain-block to which is attached a frame made of angle-iron. This frame is designed to engage the iron lugs that are riveted into the supporting-rods of the cathodes. An overhead trolley serves to convey the chain-blocks and their load to the lower end of the vat-room where the stripping is done. The sheets of zinc are about $\frac{1}{16}$ in. thick and are comparatively compact and uniform, although there are occasional boils, blisters, and rough spots. To assist in stripping and to prevent warping and irregular wearing along the edges of the aluminum sheets, wooden strips, 36 in. long and $\frac{3}{4}$ in. square, with a narrow groove $\frac{3}{8}$ in. deep along one edge, are fitted tightly over each side of the cathode. These are removed by the employees who do the stripping; the sheets of zinc are then loosened and peeled off, after which the alum-

inum is swabbed with a wash of dilute sulphuric acid before being returned to the vat. This wash has been highly effective in improving the character of the zinc deposit, the reason probably being that the cleaned surface is in good condition to receive the first particles precipitated. The wooden strips are of course replaced.

MELTING THE ZINC. The stripped zinc sheets are carried by wheelbarrow to a small coal-fired reverberatory melting-furnace, with a hearth 7 by 12 ft., in which the temperature is maintained at from 600 to 700°C. Here the dross of zinc oxide is skimmed after which the zinc is ladled and cast into 50-lb. ingots, marked 'Judge Electric', ready for shipment. These ingots are exceptionally high-grade, the analysis showing 99.94% zinc with small amounts of lead, cadmium, and iron. The dross now amounts to 15% of the gross weight of the cathodes, but improvement in the electrolytic department is expected to reduce this proportion materially, although the product contains 89% zinc and is practically free of lead so that there is a ready market for it.

The electrical equipment was furnished by the General Electric Co., the principal machines being two units, each composed of one 1750-hp. synchronous motor, Type AT 1, operating at 720 r.p.m. from a 2200-volt, 3-phase line, and one direct-current generator, Type MCF, capable of producing 5000 amperes at 250 volts. Imperfect conditions in the cells at times throw an excessive load on these machines, so that it has been found necessary to provide means for mechanical cooling. For this purpose a Sturtevant blower, size 10, drawing air through a 6 by 10-ft., type H, washer was installed. The cooled air is forced through large sheet-iron pipes to the vicinity of the windings of the motors and generators. Switch-board arrangements provide for the use of either motor-generator set to supply either of the two cell-sections independently. Power reaches the plant over a 44,000-volt transmission line and is stepped-down to 2300 volts by four 1000-kva. type H oil transformers. Sundry motors about the plant operated at 440 volts, with appropriate transformers, provide this current.

More than 20% of the cost of operating the plant is the item of power; the peculiar position of the company with respect to its resources in this particular was one of the factors that counted in the decision to build the plant. The Judge company is the owner of the Snake Creek Mining & Tunnel Co., which developed a large flow of water when driving the Snake Creek tunnel. This water is utilized by the Utah Power & Light Co., which in turn supplies power to the Judge company from any one of three independent sources, with which its transmission lines connect. This assures a constant supply of power, but does not entail the operation of a generating plant on the part of the mining company.

O. N. Friendly, general superintendent for the Judge companies at Park City, and John T. Ellsworth, superintendent of the zinc-plant, afforded me every opportunity for getting data on the operations of the plant, and I am indebted to George W. Lambourne, general manager, for permission to publish this article.

Educating Versus Drop-Forging

By W. H. Coghill

The young man who enters the mining school "knows what he wants". But does he know what he needs? The answer is yes, and no. On the basis of appended data, those entering the mining schools of Columbia University and Mass. Inst. of Technology do know what they need, and those entering certain three isolated Western mining schools do not know what they need.

Of the five schools mentioned, a comparison of the number of graduates whose names appear in 'Who's Who in America' is striking.

Graduates Honored by 'Who's Who'

Designation of school	Number of graduates 1882-1905	Number of graduates in 'Who's Who', 1913-1914	Percentage honored
Columbia	312	26	8.3
Mass. Technical	183	8	4.4
Isolated No. 1	245	2	0.8
Isolated No. 2	138	1	0.7
Isolated No. 3	256	0	0.0

Look at Columbia's honored number: 26 out of 312. Then, again, look at the factory output of No. 1, 2, and 3: the former graduates educated to meet the ever-changing conditions of life; the latter drop-forged, as they want to be.

This is not a plea to have Western schools closed, but it is to urge that we look to the Eastern educators as a guide; they were groping with the problem of education before the West was known. Why not profit by what they have learned?

A boy stated to me a few days ago that he left the university because he was required to take language, and explained that he had two years of English in the high-school. "And that is enough", said he. He is now being hammered in the practical forge to be shaped into an assayer, surveyor, miner, metallurgist, or geologist. Will he be able to meet the conditions of the mining engineering profession twenty years from now? The chances are against him. Those who can look back that far to their school-days know that the "practical stuff" hammered in by the professors is now mere chaff.

The enrollment of the Columbia mining school is small as compared with the Western schools, because it requires three years of college training for entrance. The educators believe that this is best. Contrast this curriculum with the self-laudatory comments appearing in the technical press when a Western school "introduces a course in English".

The factory keeps its fingers on the pulse of the industrial world and supplies the commodities required tomorrow. When these are consumed they are forgotten and a new output is forthcoming. But the output of a school cannot be forgotten. The school deals with souls, not commodities to be consumed and replaced by the demands of rushing time. When the high-school graduate enters a mining school and, finding that the oil geologist is the popular product, requests that he be 'pegged' with

the geologists, it puts the selection of a course of study too much on the same basis as the ordering of a dinner. It is as if the waiter were saying, "The outlets are very fine today, sir", whereupon the boy takes the hint and orders his menu accordingly. Such a system of 'ordering' in our schools, when the 'digestive organs' are not sufficiently developed to stand the 'cramming', will bring forth an output that will live to shame the 'factory'. The older educational institutions have found that it is best to require a period of development through college training before allowing the student "to place his order". Should we not profit by their experience? If we do not, our products will lack the solid foundation and basic principles necessary to keep them up with the procession.

The teachers in the isolated mining school are placed in an odious position when they are required to be practical while placed between four walls, floor, and ceiling, and the student is losing the opportunity to get the foundational work upon which a superstructure can be built or altered or re-built, as occasion shall arise and experience shall dictate.

I plead as a victim to the drop-forge system of 'education', which I would see discarded.

THE ZINC INDUSTRY in 1920 in foreign countries is briefly reviewed by the U. S. Geological Survey. Of the European zinc-producing centres, Belgium and Upper Silesia seem to be in the best condition. Belgium started the year with a smelter output of about 4500 tons monthly, which it brought up by the middle of the year to about 8000 tons. After that the output remained about stationary, so that the total production for the year was probably about 90,000 short tons. Reports near the end of the year indicate that the output is slackening and considerable stocks are on hand. The total stocks in Europe are thought to amount to 100,000 tons. Belgian smelters have recently contracted for a supply of Australian zinc concentrates. The zinc output of smelters in Upper Silesia in 1919 was 81,596 tons, equal to about 60% of the production in 1918. Reports for the first half of 1920 indicate a little larger production than in 1919, the output for the six months being 49,643 tons. The zinc industry in other European countries and in Japan is reported at a low ebb. Perhaps the most noteworthy happening in the zinc industry during the year was the acquisition of the Mount Read and Roseberry mines, Tasmania, by the Electrolytic Zinc Co. of Australasia, by which the company gains immense reserves of ore. The enlargement of the electrolytic-zinc plant at Ridsen, near Hobart, Tasmania, continues, a zinc-rolling mill and a zinc-oxide plant having been completed.

NICKEL is produced in Guiana and New Caledonia, the latter colony being the largest producer of nickel in the world, with an output of 100,000 tons. New Caledonia is, in fact, one of the richest of the French colonies, with valuable deposits not only of nickel but of lead, zinc, silver, manganese, antimony, mercury, and a small amount of gold.

The Economic Aspect of Economic Geology

By Charles A. Porter

Economic geology is commonly viewed purely as a branch of physical science. As the name indicates, however, there is an economic element, and when this latter is examined, and its influence investigated, it is found to be a factor that must be considered in order to form a complete conception of what economic geology is. Examination will show there are striking differences between the economic and physical sides of the subject. It should be especially noted that the physical factors are, to all practical purposes, completed, and are therefore fixed and invariable in their nature; while the economic are still active, and display an ever variable and changeable nature. Indeed, it is in the economic influences that we find the factors that determine what shall, and what shall not, be economic geology.

In order to realize fully the separateness of the physical and economic elements, one has but to consider the common segregations of minerals that exist today as deposits of copper, gold, or silver, and to realize that they have lain practically unchanged for untold ages, extending back to a time long before man had yet reached a stage that could be called man, and before he had yet any idea that the metals could be utilized. Such a conception will give us a condition in which the physical agencies had been exercised to the full. They had, to a high degree, concentrated those metals that today are economically valuable. The physical processes were as complete as at present; but in the absence of value, it is indeed difficult to say that there was such a thing as an ore deposit. An extreme concentration of quartz under the same conditions would as truly have been so termed. At the time such deposits were formed, it may be said, they were equally 'useless'. That is, they lacked the 'utility' which has been recognized by the economist as essential to the existence of value. There were no minds that, after the physical processes were completed, could take the metal-liferous concentrations and, through intricate processes, fit them to the complicated needs of the independent purposive actions of the highly evolved organism we know as man. Without these minds, and the needs of mankind, and also the realization of these needs, there was simply a mass of relatively homogeneous matter, and 'ore' could not exist until the coming of these phenomena which are incidental to the psychozoic age. Economics and economic value were non-existent; as the utilities that form the foundation of economic worth were yet to be brought into being.

Recent instances of these conditions are found in the cases of tungsten and molybdenum. Before the rise of modern technology, tungsten was of but little, if any, use. With the growth of the steel industry, and a knowledge of the attributes of tungsten-steel alloys, tungsten has developed a measure of utility; and what were once

deposits that no one a century ago would have called 'ore', now properly received that appellation. Still more modern is the case of molybdenum. This metal has been of but trifling economic value until recent years. Today its price is regularly quoted, and its use seems to be steadily increasing. These deposits have ceased to be merely subjects of scientific study or of simple curiosity, and in a few decades, through processes entirely unrelated to the cosmic processes that resulted in their formation, have become deposits of economic importance.

Economic value, at least as far as ore is concerned, being but a concept of the human mind, it is to be expected that it should be anything but of a fixed and stable nature. Economic value results from a mental condition that selects particular segregations, showing a 'preference' for this or that mineral. In the last analysis, value is dependent on desire, as well as utility, and the ever-shifting and insubstantial nature of these factors cannot be better expressed than in the words of a French economist: "As a shadow follows a butterfly from one flower to another, so utility accompanies desire, and abides only where desire rests." Hence we may see how the instability of the economic factor of geology stands in marked contrast with the completed physical aspects. And with the recognition of the economic factor and its influence in determining what shall and what shall not be 'ore', we must see that the science of geology, even though it attain, on its physical side, to the precision and perfection of mathematics, must always be subject to the modification of the independent and variable economic element. The latter being an influence of extreme complexity, changing with the general demand for the mineral contained in the deposit, with the difficulty of its exploitation and the energy of those who are in a position to exploit it, it will vary in proportion as substitutes are developed, or exhausted. Indeed, it will vary with the development of the science itself. It is obvious, if economic geology should attain to such perfection that any adept could, by a superficial examination, infallibly state that an orebody of certain dimensions, character, and value existed at a particular point underground, that many such deposits would readily be found, and the economic value of each certainly would fall. Hence we see that economic geology, by its own successful use, would ultimately alter the economic status of existing orebodies.

In this economic aspect and its variability, we find one of the great limitations of the geologist. He may be master of the physical processes, and such factors in any given deposit may be fully understood by him. He may rise to any degree of perfection in his prognostications, but his powers are limited to the location, volume, and

mineral composition of the deposit. He may say today: "It is not ore", and tomorrow the shadow of the butterfly may fall upon the deposit. Once pure science enters into the hurly burly of the business world, it finds itself in a never-ending series of compromises. In the case of economic geology, where in the last analysis, physical results are influenced by the desires and wants of the masses of humanity, the hard and fast facts of nature are modified in their effects by ever-changing circumstances that vary with the mental states of mankind. Fires, floods, wars, whims, fads, all may contribute. It is said that in the middle of the seventeenth century, a craze for tulips obsessed the Hollanders. At that time, this particular flower outstripped the precious metals in value. One root brought "four fat beef, eight pigs, twelve sheep, ten-hundred weight of cheese, two tuns of wine, one full attire (which probably means a suit of clothes), one cup of silver, a great quantity of wheat, and other provisions to the value of 25,000 florins". It is obvious that a fad for silver, of but a fraction of the intensity of the tulip craze, would raise many now worthless rocks to the status of 'ore'.

In the main, however, there is more or less regularity to the desires of man. They are, therefore, influenced greatly by the supply, and as desire is satisfied, the demand diminishes. Hence the economic geologist should realize that the supply of ore deposits finds its limitations precisely as shoe-factories do. A few only can be of pre-eminent success, a great many more will be mediocre, and a large class will just exist in the marginal region that economic forces have decreed lie just above that vast region occupied by economically worthless substances.

From the foregoing it should be seen that the selective action of mankind is the determining factor in what is, and what is not, 'ore'. And that the conception of 'ore' is human, and perhaps transient in the evolution of the cosmos. Should mankind ever attain to the transmutation of the elements, it may not be improbable that the metals can be produced more cheaply than can be done from the richest deposits. This is, of course, the alchemist's dream; but the study of radio-activity has again brought us back to first principles, and the transformation of radium into thorium and helium, and the practical certainty that lead is a radium residue, may well disturb our beliefs that the elements have always been fixed. Should transmutation become a fact, the conception of 'ore' will disappear, and a builder of the future may yet toss pieces of quartz heavy with gold and silver into the concrete along with the rest of the broken stone.

PETROLEUM always occurs as a liquid. Its more volatile parts may be taken into the air by evaporation or into dry clays by absorption, but the solid or semi-solid substance that remains is not called petroleum, but is known as asphalt, albertite, grahamite, or ozokerite, or by the more general term bitumen. Although all petroleum is liquid, they differ in their qualities; the same well often producing various grades.

Lead Poisoning

Lead poisoning results usually from breathing or swallowing lead in the form of its salts. In the smelting, refining, and mining of lead it occurs more frequently than in other industries says R. R. Sayers in 'Miners' Safety and Health Almanac', issued by the Bureau of Mines.

When lead occurs only as a sulphide (galena) the opportunity for lead poisoning is materially lessened, owing to the insolubility of the ore. When the ore is in the form of oxides, carbonates, or sulphates, it is much more soluble, and the danger of lead poisoning is proportionately increased. These lead salts are slightly soluble in water, and poisoning may result from drinking water containing them. Around smelters, in addition to the dangerous carbonate and oxide ores, the galena becomes changed, during the roasting and reducing processes, to these more soluble forms. The fumes from the sintering machines, blast-furnaces, etc., are dangerous, as is the dust about the charge-floors, feed-floors, flues, and bag-houses.

The disease is usually chronic, but may have sudden increases in the severity of any or all of the symptoms simulating an acute attack. Constipation, headache, metallic taste, a blue line on the gums where they join the teeth, and abdominal cramps are common symptoms. In more severe attacks there may be marked anemia, wrist-drop, toe-drop, and convulsions.

The chief factors in the prevention of lead poisoning about mines and smelters are:

1. Mechanical means of handling lead-bearing material.
2. Adequate ventilation, usually artificial, for the control of dust and fumes.
3. Use of water freely to prevent the formation of dust.
4. Medical supervision, physical examination of workmen at regular intervals, and prophylactic treatments.
5. Education of the workman as to the causes of the disease and as to means of prevention.

In the education of the workman, instruction in personal hygiene plays an important part. He should never go to work without first having an ample meal (lead absorption is apparently more rapid when the stomach is empty); he should not work in his street clothing, but should have all of his work clothing washed frequently; he should not eat while working, nor smoke or chew tobacco; he should not put his hands about his face without having washed them first; he should drink water and milk plentifully, having first thoroughly rinsed his mouth; he should not allow himself to become constipated. When he has to work in fumes or dust, he should wear a respirator; when leaving work he should always take a shower bath; if he feels at all sick, he should consult a physician at once.

A flow of one second-foot of water equals 7.48 gal. per second or 40 miner's inches.

Mining in Alaska in 1920

*Mining in Alaska began in 1880 and up to the close of 1920 minerals had been produced to the value of \$460,240,000, over half of which is to be credited to the last decade. About 75% of this mineral wealth has come from the small but rich deposits termed bonanzas. Such deposits can be profitably exploited even under the most adverse conditions of isolation and transportation, because they yield large returns on the capital and labor employed.

Bonanza mining, always the first to be developed in a new land, is a most powerful agency in attracting population, in forming communities, and in establishing transportation systems. Such mining will continue, for the known bonanza deposits in Alaska have been by no means exhausted, and there is good prospect of finding others. A stable and permanent mining industry cannot, however, be founded on the exploitation of only the very rich orebodies. Permanency must be based on the development of the larger deposits of lesser unit value. Such development depends for its profits not so much on the richness of the ore as on economies made possible by the magnitude of the operations. Large mining operations cannot be successful at places that are served only by the haphazard and expensive means of transportation generally available on the frontier. The passage from bonanza mining to a stable and permanent industry has naturally taken place in all mineral-bearing regions and has long been under way in the accessible coastal region of Alaska, but the great mineral wealth of the Interior remains practically untouched except by the bonanza miner.

The minerals won from the large low-grade orebodies of Alaska have a total estimated value of \$105,000,000, most of it in gold, the remainder including the value of copper and other minerals.

The above estimate includes the output of (1) auriferous lodes, whose gold and silver content is valued at less than \$2.50 per ton, (2) copper ores containing an average of not more than 3% of copper, (3) placers having a gold content worth less than 75¢. per cubic yard, and (4) marble and gypsum of south-eastern Alaska. The output of

the low-grade deposits has come mainly from the gold mines of Juneau, but it also includes the product of some of the larger copper mines of Ketchikan and Prince William sound and a large part of the gold recovered by dredging in Seward Peninsula. All the low-grade deposits thus far developed are at or near tidewater and have therefore not had to bear the high cost of land transportation, which can be borne only by bonanza deposits. Many mineral deposits of low grade are known in Alaska, and the prospect of finding others is good.

The long interdiction on the use of the mineral fuels of Alaska has greatly retarded all forms of mining in the



MAP OF ALASKA

Territory. It not only enhanced the cost of all mining by prohibiting the use of local fuels, but it made the industry lose the advantage of the improvement in industrial conditions that would certainly have followed the development of coal and oil.

The situation was relieved somewhat by the coal-land leasing act of 1913, but unfortunately this relief came at about the time when unstable industrial conditions were brought about by the War and by the readjustments that followed peace. In 1920 further help was given by the passage of an oil-land leasing act, but it has been passed too recently to affect the Alaska mining industry as yet.

As about 96% of the value of the mineral output of Alaska has been taken from her gold and copper mines, the world-wide depression in the mining of these two metals, which continued through 1920, has been a staggering blow to the prosperity of the Territory. About

*Abstracted from the advance statement by U. S. Geological Survey.

60% of the population of Alaska has heretofore been directly or indirectly supported by gold mining. With the relative decrease in the value of gold the miner and prospector have been forced to leave the Territory and the population has declined. This decline, however, must not be regarded as an indication of the early exhaustion of the gold reserves, for Alaska contains enormous potential reserves of gold and other minerals.

Though the mining industry of Alaska as a whole suffered a serious depression in 1920, yet the value of the total mineral output was greater than in 1919, chiefly because of the great increase in the production of copper, largely to be credited to the four large copper mines controlled by the Kennecott Copper Corporation. The value of the total mineral production of Alaska was \$19,620,913 in 1919 and about \$22,070,000 in 1920. The output of the gold placers has decreased, but that of the gold lode mines has been maintained.

Value of Mineral Production in Alaska in 1919 and 1920

	1919	1920
Gold	\$ 9,420,032	\$8,000,000
Copper	8,783,003	12,400,000
Silver	705,273	900,000
Platinum and other metals	73,603	80,000
Tellurium	73,100	20,000
Lead	72,822	142,000
Coal	343,547	380,000
Petroleum, marble, gypsum, quicksilver, etc.	143,113	148,000
Total	\$19,620,913	\$22,070,000

One of the most encouraging features of the year's mining was the systematic development of a large auriferous lode in the Nixon Fork (McGrath) district in the upper Kuskokwim valley. This orebody gives promise of being valuable, and if it so proves it will assure the beginning of a lode-mining industry in this remote region. Auriferous mineralization appears to be rather widely distributed in the Kuskokwim basin, a region which has been relatively little prospected.

The discovery of this lode and the continued success of the Candle Creek dredge, near McGrath, has attracted attention to the Kuskokwim basin, and there has consequently been more prospecting in this Province than in any other part of inland Alaska. Especially noteworthy has been the considerable search and tests for dredging ground in the Kuskokwim and immediately adjacent region during the last two years.

Though lode mining in south-eastern Alaska is still chiefly confined to the low-grade ores of Juneau, whose development is most seriously handicapped by existing conditions, yet there was in 1920, a marked increase in the prospecting for auriferous lodes in this field, notably in the Sitka district. Some promising discoveries of auriferous quartz were made on Chichagof island.

Important also are the activities in the Willow Creek district, tributary to the Government railroad, directed to the consolidation of some auriferous lode properties and their development on a large scale.

One of the most important events of the year was the beginning of systematic underground exploration of the Matanuska coalfield under the auspices of the Navy Department. This exploration has for its purpose the de-

velopment of high grade coal for the use of the Navy, but incidentally it will afford a thorough test of the commercial possibilities of the field.

The enactment of the oil-leasing law in February 1920, together with the world-wide search for petroleum, has again attracted public attention to the oil in Alaska. There has not yet been sufficient time to drill under the new regime, but more than half a million acres of land has been staked on the assumption that it is oil-bearing. The evidence at hand indicates that though a part of this land is well worth drilling many locations, as during all oil booms, will be found worthless. There is, however, good prospect of developing producing wells in Alaska.

During 11 years Alaska has produced gold to the value of \$320,000,000, of which \$221,642,000 is to be credited to her placer mines. For reasons already stated there was less placer mining in 1920 than in 1919, and the outlook under present economic conditions for a revival of the industry as a whole is not hopeful. In the following table the production of placer gold in Alaska in 1919 and 1920 is allocated by regions. This table shows clearly that the decrease in output is due chiefly to the decline in the production of the more isolated districts.

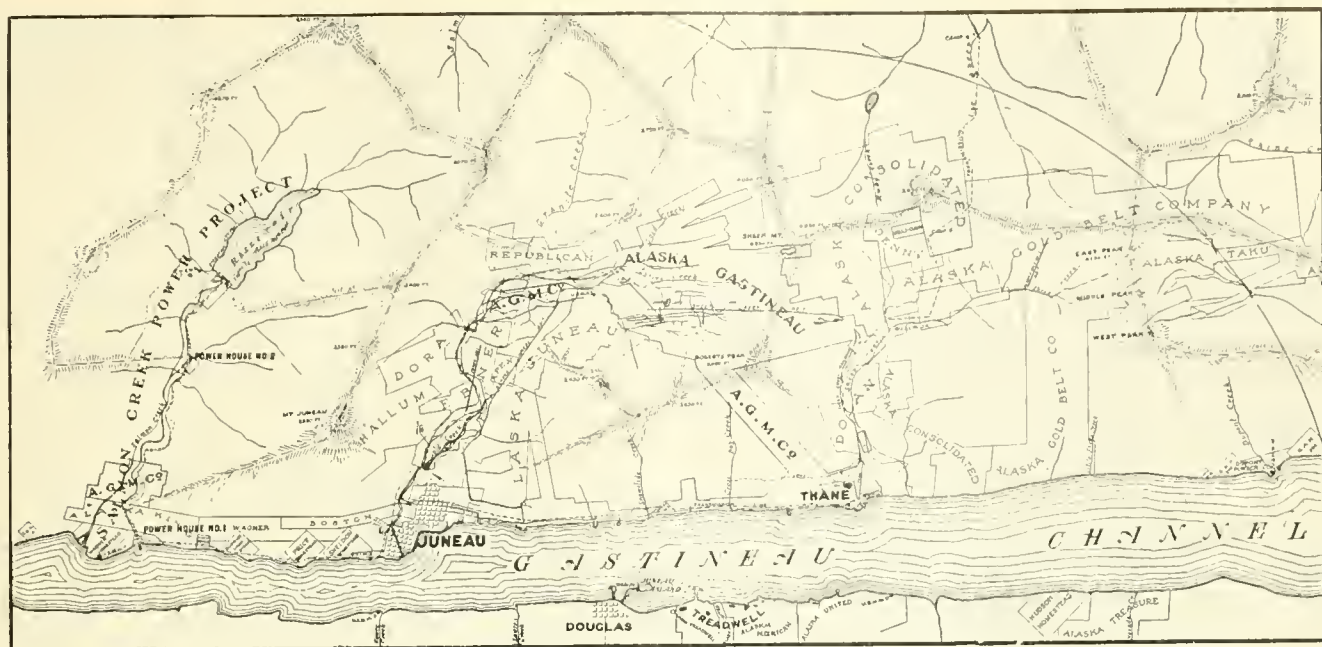
Estimated Value of Placer Gold Mined in Alaska in 1919 and 1920

Region	1919	1920
South-eastern Alaska and Pacific Coast region	\$30,000	\$10,000
Copper River Basin	185,000	175,000
Cook Inlet and Susitna region	110,000	65,000
Yukon Basin	2,910,000	1,725,000
Kuskokwim Basin	350,000	400,000
Seward Peninsula	1,360,000	1,240,000
Kobuk region	25,000	15,000
	\$4,970,000	\$3,630,000

In 1920 there were 17 gold dredges operated in the Seward Peninsula, 2 in the Iditarod and Fairbanks districts, and 1 in the Mount McKinley (McGrath) district. Improvements are being made in the Cache Creek dredge, in the Yentna district, and this will probably be operated next year. Plans are also being made for installing two dredges in the Innoko district, and for the exploitation of other dredging ground in the Kuskokwim region. Owing to the present high operating costs most dredging companies will consider only placers whose gold content is 75c. or more per cubic yard. The average recovery of the dredges in Seward Peninsula in 1919 was only 52c. per yard, and the extensive reserves of dredging ground in the Peninsula are consequently now attracting little attention.

It is estimated that 15 gold lode mines and five prospects were operated in Alaska in 1920, producing about 3,270,000 tons of ore, from which \$4,360,000 worth of gold and 106,000 oz. of silver were recovered. The output in 1919 was 3,262,573 tons of ore, containing gold to the value of \$4,392,237 and 108,691 oz. of silver. Seven of the gold mines operated in 1920 were in south-eastern Alaska, five in the Willow Creek district, two at Fairbanks, and one in the Copper River region. The prospects, which made only a very small output, are in Kenai and Seward peninsulas and in the Fairbanks district.

Eight copper mines were in operation in 1920 produc-



MAP SHOWING MINES NEAR TREADWELL AND JUNEAU, ALASKA

ing 330,000 tons of ore from which 71,000,000 lb. of copper, 710,000 oz. silver, and \$12,000 worth of gold were recovered. This brings the total copper production of Alaska to 616,000,000 lb. of which more than half is the output of the last decade.

As in past years only four mines made a large output; one of these is on Prince William sound and the others are in the Kotsina-Chitina district.

The Rush & Brown was the only copper mine operated in the Ketchikan district during 1920, though some copper was recovered from the platinum and palladium ores of the Salt Chuck mine. Developments were continued on copper-gold property on William Henry bay, in the Skagway district. On Prince William sound the output of the Beatson-Bonanza overshadowed all other operations. At the adjacent Girdwood mine much work was done and preparations were made to install a mill. Systematic development of the Rhea Cove copper property was continued during a part of the summer. The Schlosser mine, on Fidalgo bay, was operated on about the same scale as in the past, and some copper was produced in the course of work at the adjacent McIntosh mine. Except for some prospecting and assessment work there were no other copper developments on Prince William sound. In the Kotsina-Chitina district some work was done on a number of copper properties, but the only productive mining was that at the Kennecott group of mines. Some new deposits of copper ore were discovered in 1920 in the region tributary to the Government railroad, but there were no important developments.

In 1920 Alaskan mines produced about 887,000 oz. of silver; in 1919, 488,034 oz. The lead production increased from 564 tons in 1919 to about 880 tons in 1920. The increased output of silver was largely won from the copper ores, but this increase like the increase in the production of lead, was in part won from galena ores mined in a small way at several localities. The largest ship-

ment of galena ore was made by a small mine in the Kantishna district.

About 31 tons of stream-tin concentrate was mined in Alaska in 1920, compared with 86 tons in 1919. Most of this tin was mined in the York district, at the west end of Seward Peninsula, where one dredge and several small operators were working on placer tin deposits. Several tons of stream tin was also recovered from gold-placer mining operations in the Hot Springs and Ruby districts, but this was not shipped. A total of 35 tons of stream tin was shipped from Alaska in 1920, but a considerable part of this was mined in previous years.

The gold placers of the south-eastern part of Seward Peninsula, from the Chistochina (Slate Creek) district, and from some other districts, continued to yield some platinum in 1920. The Salt Chuck lode mine, in the Ketchikan district, also continued to produce platinum and palladium, as well as copper, in 1920.

Work was continued at the Parks quicksilver mine, on lower Kuskokwim river, in 1920, and some cinnabar ore was produced. A small shipment of cinnabar ore was also made from a prospect in the same district.

At the Mt. Morgan mine in Queensland, Australia, two compound May jigs have been added to the concentrating plant to take $\frac{1}{2}$ -in. ore from rolls, and the tailing from the Hancock jigs after it has been fine-ground through rolls. The tailing from the new jigs goes to a three-compartment spitzkasten, the underflow from which goes to tube-mills, and the overflow to Wilfley tables. The May jig concentrate goes to a trommel, which separates it into under and over 3 $\frac{3}{32}$ in., the oversize going direct to the smelters with the Hancock-jig concentrate, and the undersize to the sinter plant, after a small proportion is separated by a classifier and added to the product sent to smelters. A 35-ft. Dorr thickener has also been added to the plant.

Karl Eilers v. Guggenheims

Herewith we give the text of the letter addressed by Mr. Eilers to his fellow stockholders.

January 6, 1921.

To the Stockholders of the

American Smelting & Refining Company.

Gentlemen:

Doubtless you have seen in the public press of recent issues the many articles concerning the Messrs. Guggenheim and their unfortunate administration of the affairs of the American Smelting & Refining Company. From these articles you may have gained the impression that the outlook for the company is not promising and may have considered the advisability of selling your stock. In view of this possibility, I feel impelled to advise against any such sale. I most strongly urge you to retain your stock. In my judgment with proper management the future for our company is bright. The opportunities for development I believe to be practically limitless, provided the strangle-hold of the Messrs. Guggenheim on our company is broken.

To that end I have decided to urge upon the stockholders the election at the next annual stockholders' meeting of a Board of Directors whose only interests will be those of the company and its stockholders, in order to place the American Smelting & Refining Company in the predominant place which it should occupy in the basic industry of mining, smelting and metal refining.

To show the necessity for such action I consider it my duty to make known certain facts.

When the Guggenheim family first came into the company their interest was a thirty-five million dollar one. It now appears that they have disposed of about 90% of their stock.

While in control of the company's affairs the Messrs. Guggenheim have secured and developed many other enormous mining properties, not for the company's account, as should have been the case, but for their personal benefit, in marked contrast with the way that other similar industrial organizations have been built up.

With an ownership so small and with their personal interests elsewhere it could hardly be expected that the Guggenheims would look upon the A. S. & R. Co. as their first consideration.

As indicative of this, very recently it has been announced that the Selling Agency for the copper production of the

Utah Copper Company,
Nevada Consolidated Copper Company,
Chino Copper Company,
Chile Copper Company,
Braden Copper Company,
Ray Consolidated Copper Company,
Beatson Copper Company,
Kennebecott Copper Company,

was transferred from the American Smelting & Refining Company to Guggenheim Brothers, Inc. This deprives the American Smelting & Refining Company of commis-

sions aggregating from \$750,000 to \$1,000,000 per year.

You should also know that there have been losses of millions of dollars caused by the Guggenheims changing the policy of marketing copper, and adopting one which seems nothing less than gambling, such as selling copper for future delivery without at the same time protecting the company, and also withholding copper from sale when it ought to have been sold and until a serious drop in price had occurred. Instead of a large cash balance and several millions in Liberty bonds, the situation a year ago, the bonds have been sold and the company has been obliged to borrow several millions of dollars.

The power of the Guggenheims in the affairs of the company has depended on the acquiescence of the stockholders who, not knowing that they had quietly sold out most of their holdings, have continued year after year sending proxies as requested, and thus perpetuated the control of the Guggenheim board.

In the light of recent disclosures, do you desire to continue this policy? If not, the remedy is to take the management of the company into your own hands, and, at the forthcoming annual meeting in April, eliminate the Guggenheim influence from the Board.

To that end, I seek your co-operation and constructive help. If you wish me to represent you, the enclosed form of proxy to Mr. Edward D. Emerson, of Boston, another stockholder of long standing, and myself, should be signed and returned to the above address. In any event, I invite you to communicate and consult with me.

Unless you are satisfied with the showing which the company has made in the past, I urge that without the fullest investigations you do not comply with official or other requests for proxies which may be used in the interests of the Guggenheims.

There have been many other acts to the serious detriment of the company, but at this time I will not enlarge upon the reasons why your interests demand a change of management. Some of them are set forth in the enclosed copy of the article which appeared in the New York 'Tribune' of December 21, which I ask you to read.

Very truly yours,

KARL EILERS.

THE production of primary metallic zinc from domestic ores in 1920 was about 449,000 tons and from foreign ores about 14,000 tons, a total of 463,000 tons, compared with 452,272, 13,471, and 465,743 tons, respectively, in 1919. Of the output of domestic zinc in 1920 about 51,000 tons consisted of electrolytic zinc, as compared with 27,056 tons in 1919. In addition to primary zinc there was an output of about 20,000 tons of re-distilled secondary zinc, compared with 19,748 tons in 1919, making a total supply of distilled zinc and electrolytic zinc in 1920 of 483,000 tons, of which 81,000 tons was high-grade zinc, 34,000 tons intermediate, 51,000 tons select and brass-special, and 317,000 tons of prime Western. The production of the corresponding grades in 1919 was 45,377, 39,173, 140,917, and 260,024 tons, respectively, a total of 485,491 tons.

REVIEW OF MINING



FROM OUR OWN CORRESPONDENTS IN THE FIELD

ARIZONA

CATTLEMEN CLAIM DAMAGE TO RANGES FROM SMELTER SMOKE.

JEROME.—Cattlemen of the Verde valley are claiming large damage to range grass through the action of sulphuric gases settling from the stacks of the United Verde smelter at Clarkdale and the United Verde Extension smelter at Clemenceau. Before the reduction works were built there were many farms in the vicinity, and as the owners established claims for damages in the courts their holdings have been purchased by the companies, which have acquired large arceage in what are called 'smoke farms'. The claim that range grass is injured in a like manner is something new.

MIAMI.—Assessment work amounting to \$6000 has been completed by the Miami Consolidated Mines Co. on 60 unpatented claims by the sinking of shafts and tunneling. Notices have been posted on all claims showing that the assessment work has been completed.

TUCSON.—A good showing of chalcopyrite is reported to have been opened in the new shaft of the Arizona-Tucson Mining Co. in cutting a station on the 650-ft. level. The ore was entered in driving north toward the big ore-shoot that shows on the surface, and is taken as an indication that the orebody in the glory-hole goes to that depth and changes to sulphide. Operations on the Saginaw property, adjoining, will be undertaken shortly, and the shaft sunk to a depth of at least 1000 feet.

BISBEE.—The Junction mine, the principal property of the Calumet & Arizona Mining Co., was closed down for five days last week while a new air-line was being installed in the shaft. It was found necessary to increase the size of the old line.

HAYDEN.—It is announced that a company represented by Hugh H. Hanger, of Washington, D. C., has purchased the '79' mine from the Continental Commission Co. The terms of the purchase have not been revealed, but it is understood that a large cash payment is to be made, part of which has just been paid to close the deal. The property was owned by Dennis O'Brien, who held it since 1879 and who refused to sell. At O'Brien's death the property passed to his brother, then in turn to his heirs, from whom it was purchased about a year ago by the Continental Commission Co. The property consists of 23 mining claims and prior to a year ago had not been prospected to any great extent. The ore is lead-silver and copper. During the past year 70 cars of high-grade ore were shipped to El Paso.

MEYER.—It is announced by the management of the Binghamton mine that development will be resumed in 90 days to make preparations for full-scale production when the copper market is again normal. It is intended to put on about 40 men.

OATMAN.—Development work has been resumed at the Gold Road mine. A cross-cut is being run to cut the vein on the 650-ft. level; 60 ft. of work has yet to be done. Ore on the 200-ft. level has been opened that is said to run \$100 per ton for a width of three feet.

COLORADO

MINING BY LESSEES AT CRIPPLE CREEK IS ACTIVE

ASPEN.—Mining and transportation rights having been secured by John T. Boyd, mining engineer, operations will shortly be resumed on properties intersected by the Cowenhaven tunnel. Among the properties to be developed are the Homestead or Koch ranch property on Hunter creek, three miles north of Aspen. The tunnel traverses many of the older producers of high-grade ore. A force of men is at work clearing out the tunnel and laying track, and other men are employed overhauling machinery in the Hunter Creek mill and getting the mill in shape to resume treatment.

CRIPPLE CREEK.—A depth has been attained of close to 850 ft. with the diamond-drill prospecting in the north-eastern section on Galena hill. Production for January is expected to show material increase, as practically all mines operating are working full-handed and daily shipments are above the December average. Work at many properties has been resumed under lease.

Gold ore, bringing settlement at the Golden Cycle mill at the rate of \$120 per ton, is being mined on the Rankin lease on the Jerry Johnson mine on Ironlad hill. The property adjoins the Hardwood of the United Gold Mines Co., whose lessees continue to ship high-grade ore.

DENVER.—The Colorado Chapter of the American Institute of Mining and Metallurgical Engineers at the recent annual meeting elected Richard A. Parker chairman for the ensuing year; F. G. Gilbert, vice-chairman; H. F. Lunt, secretary-treasurer; and R. M. Henderson, member of the executive committee.

GEORGETOWN.—Miners are engaged cleaning out the Burleigh tunnel, preparatory to resumption of work on the Dives Pelican mine. G. L. Cole and Missouri associates plan to extend the Capitol drift into Colorado Central ground. The heading of the Capitol lateral is about 1000 ft. distant from the known orebody exposed

in the workings of the Colorado Central shaft and will cut the vein 100 ft. deeper than the present workings. The mill is also being overhauled preparatory to treatment of low grade ores left in the Dives-Pelican stopes. The Bellevue-Hudson is active under lease and ore is being saved for shipment.

IDAHO SPRINGS.—The Humboldt property on Ute creek, idle since operated by the late Julius Heil, who mined and shipped a good tonnage of high-grade ore from the mine, is again active under lease to the firm of Egan & Rufenacht of this city. The lessees are operating in one of three adit-tunnels on the property, all of which have produced ore in the past.

MICHIGAN

COPPER PRODUCTION.—J. PARKE CHANNING IS OPTIMISTIC.

CALUMET.—December production of the Calumet & Hecla group, totaling 7,514,300 lb., is an increase of 678,517 lb. for the same mines over November. Alameek's refined copper output of 1,914,500 lb. compares with 1,840,000 for November; Calumet & Hecla's production of 4,754,000 compares with 4,227,099 for November; and Isle Royale's output of 845,800 compares with 768,684. The total reported by Calumet & Hecla and subsidiaries is actually 7,517,712 lb., the difference between this total and the one given above being represented by a small clean-up of copper from subsidiaries now closed. The total December production represents an increase of 190,949 lb. over the November total of 7,326,763. The November figures included 436,286 lb. produced by Osceola, representing about a half month's output, the Osceola closing on November 16, also copper produced during the half month by LaSalle and White Pine. The increase in December reflects a gain in efficiency in the underground departments; another important factor was the successful employment of automatic level scrapers in the Calumet & Hecla. The increase from Calumet & Hecla alone is particularly notable, inasmuch as the November figures included a half month's operations from the Osceola lode shafts, while the December output came entirely from conglomerate openings.

That J. Parke Channing, president of Seneca, now here on a visit of inspection, is a firm believer in the permanency of the Lake Superior copper districts was evidenced by a remark he made in an interview to the effect that "the mines of Michigan will be running when the porphyries are all closed up". He declared this district to have a great future, due to the uniformity and extent of its copper-bearing lodes and the vast area they traverse, the greater part of it as yet untouched. He believes recovery in the metal market will be much earlier than expected by many people and that Europe soon will be in the market for large quantities. Mr. Channing expressed himself as well satisfied with developments both in the Seneca and Gratiot properties. On his return East he will arrange for permanent hoisting equipment. It was the original intention to sink the Seneca shaft to the 8th level, but it now will be extended to the 10th. The

shaft has just reached the 6th and a drift on that level is to be started. Gratiot, now bottomed at the 13th, having been in the lode almost from the grass roots, will be sunk to the 13rd, a distance of about 2000 ft., at which point it will be connected with the Seneca shaft. It is believed this work can be done in a year's time.

The leaching plant of the Calumet & Hecla is still producing about 1,000,000 lb. of copper per month, of which 600,000 lb. is from the reclamation plant. Work on the Tamarack reclamation-plant buildings will be started in the spring. Early delivery of steel is expected. Much of the material, however, will be that salvaged from the old Calumet coal storage. Construction work will require the rest of the year to complete. The building for the re-grinding unit already is erected and machinery will be installed during the summer.

NEVADA

THE PEAVINE MOUNTAIN DISTRICT.

RENO.—The Peavine Mountain district, including the territory surrounding the mountain of that name north of Reno, has been attracting attention since the organization in December of the Peavine Mine Operators' Association, which has been active in bringing the district before Nevada mining men with the result that a number of additional companies have started or are planning to start work. Now development work is being done by the Black Panther, Standard Metals, Fravel Paymaster, Hager and Keefer, the Nevada Western, and the newly organized Reno Silver & Copper Co., with three other companies getting ready to start in the spring. The principal content of most of the ore of the district is silver, with a high gold and a low copper content. The vein in the Standard Metals strikes north and dips west at 35 to 50°, being more nearly vertical on the 300-ft. or bottom level, which is now being explored with a drift on the foot-wall of the vein and cross-cuts. The ore at this depth is 10 to 30 ft. wide and the average value of 5 to 10 ft. on the foot-wall is \$20 to \$30, with a narrow seam that assays much higher. This ore-shoot has been opened on the 100 and 200-ft. levels for a length of 125 ft. and an extreme width of 50 ft. The water-level is at 200 ft. The drift on the 300-ft. level is being continued and it is planned to raise to the 100-ft. level and sink the shaft another 100 ft. The ore contains neither lead nor zinc and in the summer of 1919 the company completed a 60-ton concentrator and flotation plant in which the combined processes gave one ton of concentrate and floated material to 11 tons of ore. A crusher, rolls, and a ball-mill are used, the last reducing the ore to pass 60-mesh before it is concentrated on Wilfley tables, which recover 50 to 60% of the metal. The tailing from the tables is re-ground to pass 100-mesh and this is treated in a K & K flotation machine. The Fravel Paymaster adjoins the Standard Metals on the strike of the vein and the shaft is being sunk 300 ft. from the 200-ft. level, where the orebody is 300 ft. long and 5 ft. wide, with a maximum width of 10 ft. The company plans to have ore treated in

the Standard Metals plant when it re-opens in the spring. The companies operating in the district are spending \$25,000 monthly and it is estimated that this will be increased to \$50,000 by the greater activity that is promised for the next few months.

KLONDYKE.—Two 50-ton earloads of \$35 silver-gold ore are being shipped weekly from the Golden State, where an orebody nine feet wide is being mined at a depth of 60 ft. A winze is being sunk from the 60-ft. level. The ore is at a well-defined contact between limestone and rhyolite. The Golden State is being worked under a bond and lease by the Knox Divide. Regular shipments of \$11

is stated that the average cost of producing lead in this State during 1920 was 6.06c. per pound, whereas the current price is 4.75c. Imer Pett, general manager for the Bingham Mines Co., has returned from Washington and expresses the opinion that the next Congress will place a higher tariff on lead imports.

During the week ending January 15, the Utah Ore Sampling Co. released 98 cars of ore from Utah mines and four from Nevada mines at its Murray sampler; at the Tintic plant, 34 cars of Utah ore were handled.

EUREKA.—Connection has been made between the No. 1 shaft at the Tintic Standard property and the new



THE UTAH-APEX MINE AT BINGHAM, UTAH

to \$17 ore are being made from the Maloney lease on the Original Klondyke, the material coming from dumps. Two sub-lessees are working and one of these, the Collier-Jones-Erickson, has ready a 50-ton shipment that is expected to net \$30 per ton.

UTAH

MINE OPERATORS ARE SEEKING INCREASED TARIFFS ON LEAD.

SALT LAKE CITY.—A memorial to the national Congress, calling attention to the necessity for an increased duty on lead, was presented to the State Senate on January 20. The measure has the backing of the Utah Chapter of the American Mining Congress. The memorial calls attention to the fact that the market price of lead has receded to the level that existed before the world war, while the high cost of production is unchanged. It

workings, at a depth of 1200 ft., this being the second connection, the first being on the 1000-ft. level. The second connection has resulted in better ventilation and also enables better access to some large stopes of ore. It is expected that the company's new milling plant will be in operation by February 1. During the week ending January 14, the company shipped 77 carloads of ore, which establishes a new high record for output from any one mine in this district.

During the week ending January 14, the mines in this district shipped 184 carloads of ore, of which the Tintic Standard leads with 77; Chief Consolidated, 31; Dragon, 16; Iron King, 15; Eagle & Blue Bell, 15; Victoria, 8; Iron Blossom, 7; Bullion Beck, 3; Grand Central, 3; Swansea, 3; Colorado, 2; Eureka Mines, Sunbeam, Eureka Hill, and Centennial, 1 each.

On the 1565-ft. level of the Iron King mine, two head-

ings are being driven, according to N. W. Roberts, superintendent. One of these drifts recently entered an important break, fully six feet wide, and which is now being followed to the north east. The second drift on that level is being driven to the south west. Most of the shipments coming from the property at present are obtained above the tunnel-level, which is under lease to one of the smelting companies. It is expected that the output of iron ore will shortly be increased to 100 tons per day.

PARK CITY.—Ore shipments from this district for the week ending January 15 totaled 1911 tons, of which the Judge Allied Companies shipped 600; Silver King Coalition, 595; and the Ontario, 600.

BRITISH COLUMBIA

ORE-SHIPMENTS ARE MADE FROM PORTLAND CANAL DISTRICT.

STEWART.—Shipping from the Premier mine to Stewart is now well under way. In its last trip south the 'Prince Albert' took a consignment of 400 tons, and another 500 tons will go forward on the next trip. The first consignment of 450 tons is said to have given a return of \$400 per ton. The Algonic Development Co. is making preparations for the shipping of some 100 tons of ore that have been taken out in development, and horses have been taken into the property for the purpose. These have been provided with snowshoes. The ore is complex, containing sulphides of zinc, lead, copper, and iron, and some of it assays thousands of ounces per ton in silver.

CLINTON.—Considerable local excitement has been caused by the finding of gold in the direction of Scottie creek, on the Cariboo road, and more than 100 claims have been staked. Some of the assays that have been made are said to run high in gold. In some of the discoveries the gold occurs associated with limonite.

ATLIN.—The placers of the Atlin district have not been bringing the returns nor furnishing the employment that they did in past years and residents are looking forward to the development of lode-mining properties. The property upon which they chiefly depend is the Engineer. When its title is established by the courts it is asserted that the Guggenheims will take over this mine and operate it. Atlin people, therefore, want to see the litigation brought to an issue without delay. The purchase of the Engineer by a concern having adequate financial resources would mean not only the exploitation of that property but the acquirement and development of a considerable adjacent area.

ALICE ARM.—It is said that the Bellevue group, in the Illianee River district, is showing up well, there having been uncovered a well-defined vein, samples from which have assayed 23.05 oz. of silver per ton, 0.07 oz. gold, and 3.4 to 5.4% lead. Work is proceeding this winter and the syndicate in control proposes installing a concentrator next season. The operating company is known as the Alice Arm Consolidated Holdings, Ltd.

VANCOUVER.—The Annual Convention of the western division of the Canadian Institute of Mining and Metallurgy is to be held at Vancouver on February 9 to 11. A

first class program has been prepared, among the speakers being S. J. Schofield, of the geological department of the University of British Columbia. Another contributor will be J. D. MacKenzie, of the Canadian Geological Survey.

ONTARIO

LAKE SHORE DEVELOPS ITS NEW ORE-SHOOT.

KIRKLAND LAKE.—An ore-shoot, stated to be richer than any other gold deposit so far developed in Northern Ontario and ranking in importance with the big ore-bodies of Porcupine, has been developed at the Lake Shore. No. 2 vein has been opened up for 2000 ft. on the 200-ft. level and for over 1000 ft. on the 400-ft. level. Over 1500 ft. on the upper level is in high-grade ore, one stretch of 600 ft. being solid ore from 5 to 40 ft. in width. The richness of the ore is indicated by the fact that the recovery, principally from development ore from this vein, has averaged \$25 per ton. In 1917 the then manager of the mine estimated that No. 2 vein contained indicated ore of the value of \$800,000. At that time it had only been opened up 400 or 500 ft. on one level. Since then the known orebody has been at least quadrupled by underground work. No. 1 vein, which in 1917 was estimated to contain ore to the value of \$400,000, has undergone development on the 400-ft. level which has largely increased the ore-reserves.

COBALT.—No further curtailment of operations on account of power-supply is anticipated, as it is not believed that conditions will become any worse until the spring floods bring relief. The substantial decline in operating costs due to the wage reduction of 75c. per day, announced for February 15, encourages the hope that even at present prices of silver the scope of operations at producing mines will be largely increased and work resumed on many properties now idle.

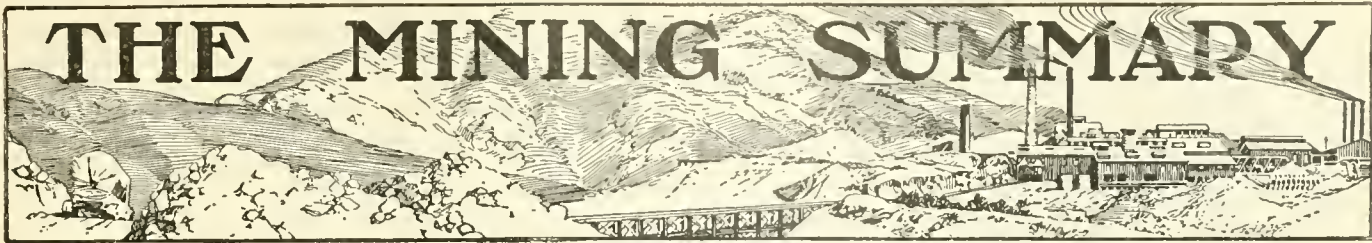
An important discovery has been made on the first level of the University property of the La Rose Consolidated, where a new vein, two to four inches wide, of high-grade ore has been found. The high-grade averages 1500 oz. per ton, with three feet of good milling rock.

The new vein opened up on the 250-ft. level of the Bailey continues strong under development and in some sections contains ore assaying from 1000 to 4000 oz. per ton.

The Crown Reserve has discontinued diamond-drilling, having reached a depth of 1500 ft. without making any discoveries of importance. No work is being done except keeping the mine free of water.

BOSTON CREEK.—At the Allied Gold Mines adjoining the Miller Independence on the north several thousand feet of diamond-drilling has been done with fair results, the drill having cut what is thought to be an extension of the 'D' vein, with indications of good gold content.

GOWGANDA.—In sinking the shaft on the 'office' vein of the Castle property from the 80-ft. level to a depth of 150 ft. a new vein carrying two inches of high-grade ore and a good width of milling rock was found. Seventeen tons of high-grade ore has been shipped.



CONFERENCE OF BUREAU OF MINES OFFICIALS AT BERKELEY

The following engineers for the U. S. Bureau of Mines are attending the conference of Bureau officials held at the Pacific Experiment Station, Berkeley, during the week beginning January 24:

D. A. Lyon, Chief Metallurgist and Supervisor of Stations, Washington, D. C.; E. A. Holbrook, Executive Officer in charge of the Investigations Branch and Chief Metal Mining Engineer, Washington, D. C.; D. Harrington, Supervising Mining Engineer, Denver; H. E. Meyer, Chief Clerk, Washington, D. C.; O. C. Ralston, Superintendent Northwest Experiment Station, Seattle; S. C. Lind, Superintendent Rare and Precious Metals Experiment Station, Reno, Nevada; Thomas Varley, Superintendent Inter-Mountain Experiment Station, Salt Lake City, Utah; C. E. van Barneveld, Superintendent Southwest Experiment Station, Tucson, Arizona; L. H. Duschak, Superintendent Pacific Experiment Station, Berkeley; B. O. Pickard, District Mining Engineer, Berkeley; C. P. Bowie, Petroleum Engineer, San Francisco; E. D. Gardner, Mining Engineer, Reno; W. C. Riddell, Chemical Engineer, Berkeley.

In addition there are present the deans of the schools at which the various experiment stations of the Bureau are situated. They are:

Dean Milnor Roberts, School of Mines, University of Washington, Seattle; Dean F. C. Lincoln, School of Mines, University of Nevada, Reno; Dean Joseph F. Merrill, School of Mines, University of Utah, Salt Lake City, Utah; Dean G. M. Butler, College of Mines and Engineering, University of Arizona, Tucson; Dean F. H. Probert, College of Mines and Metallurgy, University of California, Berkeley.

Reports were received in regard to the research work in progress at the various Experiment Stations and the plans for the future work were discussed. The subjects considered at this conference include the co-ordination of the work of the Bureau of Mines in the West and the plans for closer co-operation between the Bureau and the several universities at which Experiment Stations have been established. Co-operation between State organizations and mining companies was also discussed.

PRODUCTION OF GOLD AND SILVER

The Bureau of the Mint, with the co-operation of the U. S. Geological Survey, has issued the following statement of the preliminary compilation of the production of gold and silver in the United States during the calendar year 1920:

State	Gold, oz.	Value	Silver, oz.	Value
Alaska	380,034	\$7,856,000	792,751	\$804,745
Arizona	239,118	4,943,000	6,098,251	6,190,518
California	692,019	14,305,300	1,513,495	1,536,394
Colorado	368,298	7,613,400	5,572,407	5,656,718
Idaho	22,509	465,300	7,531,253	7,645,201
Michigan	.....	.....	510,601	518,326
Missouri	19	400	123,219	125,083
Montana	88,971	1,839,200	13,583,164	13,788,677
Nevada	171,968	3,554,900	7,392,689	7,504,540
New Mexico	22,417	463,400	764,586	776,154
Oregon	46,687	965,100	182,558	185,320
South Dakota	203,243	4,201,400	84,351	85,627
Tennessee	280	5,800	112,595	114,299
Texas	5	100	524,212	532,143
Utah	100,446	2,076,400	11,564,155	11,739,121
Washington	7,198	148,800	183,427	186,213
Philippines	51,568	1,066,000	21,917	22,249

TARIFF ON ZINC

Zinc producers as well as smelters are said to favor an increased duty on zinc ore. Obviously if the duty on ore is raised then the duty on slab and sheet zinc should also be raised for otherwise the smelters and rollers would be placed in an embarrassing position. Reports are to the effect that the committee of the American Zinc Institute, which presented argument for a tariff to the Ways and Means Committee asked for a tariff of from two to four cents per pound. Other advices are that the committee asked for the restoration of the duties that applied under the Aldrich-Payne Act in 1909. The following comparison of the tariffs of 1909 and 1913, the latter being that which now is in effect, is made:

	1909 cents	1913 %
Zinc ore containing		
Less than 10% zinc	free	10
10 to 20% zinc	1*	10
20 to 25% zinc	1*	10
Over 25% zinc	1*	10
Slab zinc (spelter)	1 ⁵⁰	15
Zinc sheets	1 ⁵⁰	15
Zinc oxide (dry)	1	10

*On the zinc contents.

On the present value of zinc in Europe the duty of 15% ad valorem is equal to around 70c. per 100 lb. or about one-half the duty which applied under the tariff of 1909.

SILVER EXPORTS FROM MEXICO

The new rates of export duty on silver, according to the decree just issued by President Obregon, are given below. When the value of silver on the New York market, as determined by the Secretary of Hacienda, either in ten-day or monthly periods, is less than 60 cents per ounce, no duty will be levied.

Value of silver	Duty to be levied, % ad valorem
\$0.60 to 0.70	1
0.70 " 0.80	1½
0.80 " 0.90	2
0.90 " 1.00	7
1.00 " 1.10	8
1.10 " 1.20	9
1.20 " 1.30	10
1.30 " 1.40	11
Greater than \$1.40	12

The decree of June 15, 1920, is abrogated under the terms of the new decree. The purpose, as stated, is "to co-operate for the solution of the present prices in the mining business and to protect the mining companies sufficiently to enable them to make profit and at the same time contribute to the Government in proportion to their earnings".

CANADIAN GOVERNMENT URGED TO PURCHASE SILVER AT EIGHTY CENTS

The latest organization to urge relief for the silver-mining industry in British Columbia by Government action is the Board of Trade of Nelson, B. C. The resolution follows in part:

Whereas the present unemployment amounts in effect to

an industrial crisis and it is desirable and behooves every good and loyal citizen to avert such crisis, and

Whereas owing to the high cost of production, many mines have been forced to suspend operations, since it is unprofitable to mine for silver at the present variable prices of the metal, and,

Whereas there is of necessity much unemployment and suffering throughout the country, and,

Whereas the establishment of the silver industry would ameliorate this state of affairs, now, therefore, be it hereby,

Resolved that this Board of Trade urges the Dominion government to take such legislative action as may be necessary to secure: (a) The control and purchase of all silver produced in the Dominion at a fixed price of eighty cents per fine ounce for a period of two years or so much shorter or longer a time as may be necessary to secure the desired objects, and (b) The withdrawal of an agreed amount of one dollar bills from circulation and the substitution of minted silver dollars:

Be it further resolved to draw the attention of the Dominion government to the fact that the United States continues to purchase silver under the Pittman Act at 92½¢ per ounce and to issue silver currency in lieu of paper money, and that still further coinage is advocated, thereby removing the metal from the world's market and making for the maintenance of silver values at a price higher than the 80¢. per ounce mentioned at the opening of this resolution.

ARIZONA

Ajo.—J. C. Greenway, general manager for the Calumet & Arizona and New Cornelia mining companies, Cornelius Kelly, president of the Inspiration Copper Co., Will Thornton, of the Greene-Cananea Copper Co., Thomas Cole, of the Calumet & Arizona Mining Co., and L. D. Ricketts, consulting engineer for the Phelps Dodge Interests and other mining corporations in the South-West, are here for the purpose of considering the proposed railroad to the Gulf of California, with a terminus at Rocky Point. A preliminary survey for the line has been completed.—The average cost of producing copper by the New Cornelia company during 1920 was less than 13½ cents per pound, despite a curtailed scale of operations. The output was 40,761,446 lb. as compared with 39,000,000 lb. in 1919.

CALIFORNIA

Angels Camp.—The new mill and cyanide plant at the Sheep Ranch mine are now operating, 100 tons of medium-grade ore being crushed daily and 90 men being employed in the mine and mill.—The improvements recently made in the mill of the Calaveras Consolidated company are proving to be of great advantage. New ore is being opened in the lower levels of the mine.

Chico.—J. M. Pitts, of San Francisco, has resumed operations at the Bader mine. A contract has been let for driving a 400-ft. tunnel to develop the ground south of the old workings, which yielded large amounts of rich ore years ago.—A new 'lead' of rich gravel is reported in the Butte mine, and additional equipment will be installed to assist operations.

Jackson.—The 3500-ft. point has been passed in unwatering the Argonaut and Kennedy mines. A wide vein of good ore on the 4900-ft. level of the Argonaut is the principal object in hastening the removal of the water.

Nevada City.—Thomas Sullivan and William Landrigan are working the old Manzanita hydraulic mine. The deposits of gravel are opened through drifts and are washed by hand.—The Jerry Goodwin property has recently changed hands and preparations are being made to operate.—Good progress is being made in unwatering the inclined shaft of the Idaho-Maryland mine. Lessees working in the upper levels have developed shoots of good ore.

Redding.—The wages of miners and shovelers at Kennett and Winthrop will be reduced February 1, according to the announcement made by the United States Smelting, Refining & Mining Co. at the former place, and by the Shasta Zinc & Copper Co. at the latter. Miners will receive \$4.25 per day instead of \$6, and muckers will receive \$3.75 instead of \$4.50, as at present. Corresponding reductions are made among other trades. Board is reduced from \$1.20 per day to \$1.

COLORADO

Rico.—A. E. Reynolds is unwatering the Emma mine near Duncan, in preparation for drifting on the vein at the sixth



level. Later a raise will be run to the fifth level. Twenty men are employed.

Steamboat Springs.—The Plateau Oil Co. drilling a test on the Chimney Creek structure, 12 miles north-west of Steamboat Springs, has penetrated 18 ft. of the first Wall Street sand. Showings of oil and gas are found but no oil in commercial quantity. The test will be continued to the Dakota sand, the productive horizon of the Rock Creek, Wyoming, field.

IDAHO

Bonner County.—According to I. E. Martin there is only 30 ft. further to cross-cut before striking the vein on the 300-ft. level of the Carpie mine. The vein on the surface near the shaft is about 4½ ft. wide. It is cross-cut at 40 ft., 75 ft., 110 ft., and at 200 ft. On the 200-ft. level there is a 130-ft. drift showing good ore through its length. The vein is 14 ft. wide, with a seam of several inches of good shipping ore, containing copper and silver. The property comprises three claims and a mill-site.

Coeur d'Alene.—The class in geology of Whitworth college, at Spokane, Washington, will make a four-day field-trip to the mining districts of Kellogg and Wallace, January 25 to 28. Fifteen are expected to make the trip. Arrangements have been made with Stanly A. Easton, manager of the Bunker Hill & Sullivan mine, for a thorough inspection of the mine and smelting plant by the students.

Further development work on the 60-ft. shaft in the Paragon mine will be begun, according to L. W. Steadman, manager. It is hoped to add another 300 ft. to the depth of the shaft before summer. When they have sunk 300 ft. more they will have to cross-cut about 200 ft. to reach the vein. Two shifts of miners have started work on the Russel tunnel of the Marsh property to drive it 700 ft. farther, thereby carrying it through the east lines of the claim. This is in pursuance with the recent court order that the Marsh company must show that the vein actually passes out through the east end-line before the court will grant permission for the Marsh people to enter the Hecla workings to raise 700 ft. and demonstrate the identity of the veins.

The Idaho Mines Leasing Co., which has a lease on the ground above the Black Bear No. 3 tunnel, expects to have its new mill running soon after the first of February. The mill will treat 50 tons of ore per day, concentrate to be delivered to the railroad-cars by means of a cable gravity tram.—The Kellogg United Mining Co. has acquired the lease of Savage & Gordon on the old Bunker Hill & Sullivan workings. The transaction includes a flotation plant, which is now being overhauled under the direction of Henry M. Thronson.

MONTANA

Anaconda.—Aluminum has been successfully made at the Washoe Reduction Works. The Anaconda Mining Co. has done extensive work in preparation for the manufacture of aluminum and has effected some economies in the consumption of power.

Basin.—The Obelisk mine-workings are being sampled with a view to developing ore in a mineralized area 300 ft. long, 100 ft. wide, and 400 ft. deep. Samples already assayed are said to show 4 to 15 oz. of silver per ton. Experiments are being conducted to determine the adaptability of the flotation process in treating the ore.

Butte.—The Davis-Daly Copper Co. has curtailed operations at its Colorado mine, where the principal output is copper. At the Hibernia mine, where silver is the principal metal, the production of 200 tons per day will be maintained. During December, 107 cars of 18-oz. ore were shipped, netting the Davis-Daly approximately \$1 per ounce for the contained silver.

Deer Lodge.—Application has been made by the Butte-Jardine company to build a six-mile power-transmission line to furnish power for the new Champion mill, which is now nearing completion.

East Helena.—The Oregon Short Line R. R. Co. has been granted permission to reduce rates on slag from Melrose to the A. S. & R. smelter.

Elkhorn.—The Boston & Montana Development Co. is reported to have purchased 20 carloads of mining machinery for equipping the first section of a 3000-ton concentrator to be erected during the coming year. Included in the equipment are two No. 7½ Tel-smith gyratory crushers, four 8-ft. by 48-in. Hardinge conical ball-mills, Wilfley tables, and Janney flotation machines. About 200 men are now employed at the property and a million tons of silver-copper ore has been blocked-out.

Marysville.—Two carloads of gold ore have been shipped from the Bell Boy mine recently acquired by the Philadelphia Mining Co. Specimen samples from the vein are said to be exceedingly rich.

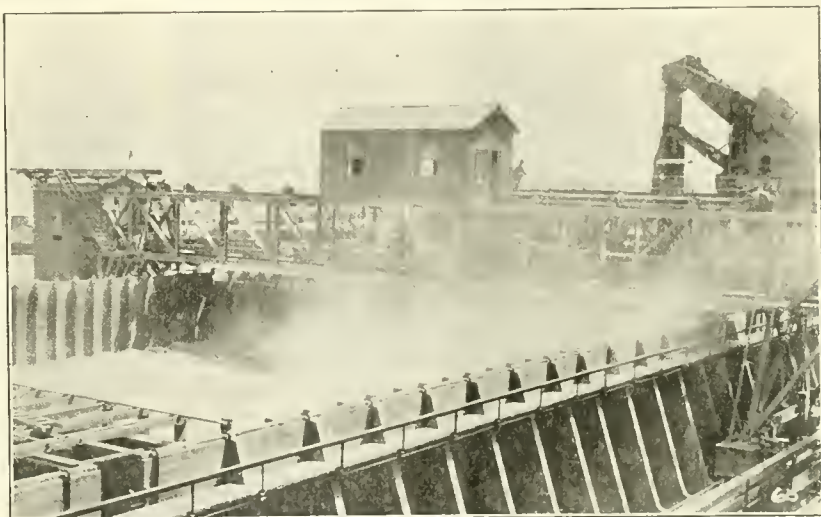
Meagher County.—The old Cumberland mine, last operated in 1893, will be re-opened in the spring, according to H. G. Klenzie. It is said that 40,000 tons of ore is blocked-

out between the 200 and 300-ft. levels, which, with lead selling at 6 or 7 cents and silver at \$1, is estimated to be worth \$2,000,000. A slag-dump from an old 100-ton smelter at the mine will also be shipped.

Neihart.—A reduction of 20% in the present freight-rate on ore valued at \$25 per ton has been authorized. This should stimulate production for shipment to the smelter at East Helena.

Arrangements have been made whereby the Cascade Consolidated Silver Mines Co. will lease and operate the old Cascade mines. The lessee will operate the Broadwater and Moulton groups, agreeing to perform a certain amount of development work each year. During the first six months the leasing company will pay a royalty of 10% of the smelter returns, this rate to be increased gradually until the royalty is 25% during the third year.

Saltese.—The drift on the 800-ft. level of the Tarbox mine has been extended 190 ft. to the east. A cross-cut is to be run to the big South vein from the 200-ft. point.



LEACHING-VAT AT THE PLANT OF THE NEW CORNELIA COPPER CO.

NEVADA

Cactus.—The Cactus Nevada is to resume work soon, according to Sol Camp, superintendent, who since the closing of the Cactus has been devoting his attention to the Arrowhead Rico lead-silver mine at Ubehebe.

Elko.—The Catlin Shale Products Co. is employing 35 men in the production of gasoline, paraffine-wax, ammonium sulphate, and producer-gas on a large experimental scale. The company has spent several hundred thousand dollars in sinking a 400-ft. shaft on a 5-ft. vein of shale and erecting its plant. The shale will yield 50 gal. per ton, according to present estimates.

Eureka.—Some of the machinery already installed in the Eureka-Holly mill has been turned over. The necessary material for the completion of the mill has arrived and construction will be completed within a month. High-grade ore is being shipped to the smelter.—Ore is being extracted from the shale raise of the Eureka-Croesus and from No. 7 winze. No. 2 raise is supplying some shipping ore, while the drift from No. 8 winze is in limestone impregnated with iron oxide.

Goldfield.—Ore that has been persistent for 20 ft. in a raise from the intermediate level 80 ft. above the 365 of the Great Bend indicates the opening of the ore-shoot for which a long and costly search has been made. The ore assays \$35 to \$70 over a 4-ft. width and it is being saved for shipment. Seventeen leased blocks are being developed in

the Consolidated, according to A. H. Lawry, general superintendent.

Pioche.—An agreement has been made by the Prince Consolidated Co. whereby 100,000 tons of tailing from Hullonville and Dry Valley will be treated in the company's mill. E. R. Richards has made numerous changes and additions to the old Prince Consolidated mill and will treat 100 tons per day with a process especially developed for the purpose.

—Machinery for the development of the Nevada Horn-silver property in the Fairview district is being delivered preparatory to work financed by the Prince Consolidated Co. —The Crystal Silver Mines Co. shipped 1200 tons during the last month.

Pioneer.—The Mayflower has levied assessment No. 6, at the rate of 1c. per share, delinquent March 1. A statement accompanying the notice of assessment shows that since April 1920, when W. J. Tobin resumed the management, the indebtedness has been reduced from \$18,000 to \$10,000. The previous assessment was levied May 18, 1920, and there was received from this \$15,520. Changes have been made in the mill, the principal one being to permit the re-use of water. Settling-tanks have been built below the mill and the water will be pumped from them.

Virginia City.—The Consolidated Virginia company milled 17,706 tons of ore during 1920, with a total net proceeds of \$259,886. —The Comstock Silver Co. is prospecting the Sheels group of claims recently purchased. A drift on the 150-ft. level has exposed ore averaging \$35 per ton.

SOUTH DAKOTA

Deadwood.—There are 1864 men on the payroll of the Homestake company. This force will probably be increased when grading of the site for the new milling plant is undertaken. The new plant will include heavy stamps and ball-mills for crushing, and will have a capacity of 2000 tons per day. It is expected to be ready for operation by autumn.

UTAH

Alta.—During the fiscal year ending September 30, 1920, the Emma Silver Mines Co. shipped 1484 tons of ore, the receipts from which were \$49,657. The company obtained \$7130 from the sale of 100,000 shares of treasury stock. The total receipts for the year were \$59,390. The total expenses during the year were \$101,716, of which \$51,207 was for wages and \$13,499 for mine supplies. The deficit for the year was \$50,999, and the cash balance October 1 was \$49,125. During the period development work totaled 781 ft. of drifts, cross-cuts, and raises, and 671 ft. of diamond-drilling. The ore produced came from a point below the 300-ft. level in the Bay City shaft. Drifting is being done on the Bay City level on what is known as the Phoenix fissure in ground heretofore not prospected.

Bingham.—The United States Mining Co. is now the heaviest shipper among the underground mines in this district, a daily output of 500 tons being shipped. —The Utah Consolidated Mining Co., formerly a heavy producer, has been curtailing production of late and now has but 200 men on the payroll, as against a normal force of 500. —The Utah-Apex company has ceased shipments of ore, and is doing a limited amount of development work.

MEXICO

Cananea.—Following out its policy announced a month ago, the Cananea Consolidated Copper Co. has shut-down its mines, mill, and smelter; 2000 employees, mostly Mexicans, are thrown out of work. They are going farther into the interior of Mexico instead of flocking to the United States where the opportunities for obtaining work are not good. The period of suspension will depend largely upon improvement in the copper market.

PERSONAL

The Editor invites members of the profession to send particulars of their work and appointments. The information is interesting to our readers.

L. C. Graton is in Peru.

Francis Drake has returned to London from Australia.

Charles F. Law, of Vancouver, B. C., is in San Francisco.

E. W. Skeats sailed from San Francisco for Melbourne on January 25.

Howard D. Smith was here last week on his way from New York to Nevada.

Veleair C. Smith has moved from Elizabeth, New Jersey, to Tuxpam, Vera Cruz.

N. H. Darton has returned from Mexico to his work on the U. S. Geological Survey.

M. R. Valentine, formerly with the Portland Gold Mining Co., is in San Francisco.

Clyde A. Heller, of Philadelphia, was in San Francisco this week on his way to Nevada.

Herbert S. King is now superintendent for the Chandler Mining Co., at Ely, Minnesota.

J. M. Callow has returned to Salt Lake City after spending some time at Superior, Arizona.

Arthur Dickenson and R. H. Conran are inspecting gold mines in the State of Goyaz, Brazil.

Henry C. Perkins has been chosen a member of the advisory board of the Super-Power Survey.

L. B. Carpenter and W. S. Larssen have removed their offices to the Balfour Bldg., San Francisco.

C. F. Courtney, mining engineer to the Sulphide Corporation, at Broken Hill, Australia, is in London.

C. S. T. Parish is assistant mine superintendent for the Amparo Mining Co., at Etzatlan, Jalisco, Mexico.

J. Benjamin Parker has become flotation metallurgist for the Bunker Hill & Sullivan Mining & Concentrating Co.

P. J. O'Gara, plant pathologist of the Utah department of the A. S. & R. Co., has returned from a trip to Washington, D. C.

E. Hogan Taylor, formerly at Great Cobar, has been appointed manager for the New Guinea Copper Mines Co. in Papua.

Theodore Pilger, of Butte and the North-West, has taken a position in the New York sales office of the Allis-Chalmers Mfg. Co., at 50 Church St., New York.

Fred J. Pack, Professor of Geology in the University of Utah, is giving a series of lectures on petroleum geology at the Commercial Club in Salt Lake City.

J. J. Lillie has resigned as superintendent for the Horn Silver Mines Co., to become assistant professor of geology in the Colorado School of Mines, at Golden.

Joseph F. Merrill, director of the School of Mines and Department of Engineering at the University of Utah, has been appointed consulting engineer of the Salt Lake district for the U. S. Bureau of Mines.

Harold A. Linke has accepted the appointment as chief field-engineer on construction work, including mills, mining plants, tramways, etc., for the Compania de Real del Monte y Pachuca, at Pachuca, in Hidalgo, Mexico.

Obituary

A memorial service in honor of Chester A. Thomas will be held in the chapel of Stanford University on January 30.

A. L. B. Germain-Griffith was killed in a motor accident at Los Angeles on January 8. He was a British mining engineer and held a military commission during the Boer war. During the recent war he served with the Red Cross.

THE METAL MARKET



METAL PRICES

San Francisco, January 25

Aluminum-dust, cents per pound	65
Antimony, cents per pound	9.50
Copper, electrolytic, cents per pound	14.00—14.50
Lead, pig, cents per pound	5—6
Platinum, pure, per ounce	\$65
Platinum, 10% iridium, per ounce	\$95
Quicksilver, per flask of 75 lb.	\$50
Spelter, cents per pound	8.25
Zinc-dust, cents per pound	12.50—15.00

EASTERN METAL MARKET

(By wire from New York)

January 24.—Copper is quiet and slightly easier. Lead is inactive and firm. Zinc is lifeless and lower.

SILVER

Below are given official or ticker quotations for silver in the open market as distinguished from the fixed price obtainable for metal produced, smelted, and refined exclusively within the United States. Under the terms of the Pittman Act such silver will be purchased by the United States Mint at \$1 per ounce, subject to certain small charges which vary slightly but amount to approximately three-eighths of one cent. The equivalent of dollar silver (1000 fine) in British currency is 46.65 pence per ounce (925 fine), calculated at the normal rate of exchange.

Date	New York cents	London pence	Average week ending Cents	Pence
Jan. 18	66.12	39.75	Dec. 13	62.54
" 19	65.50	39.50	" 20	63.77
" 20	67.87	40.62	" 27	63.77
" 21	66.75	40.00	Jan. 3	65.40
" 22	66.37	39.75	" 10	66.60
" 23 Sunday			" 17	66.14
" 24	66.75	40.00	" 24	66.56

Monthly averages			1918	1919	1920
Jan.	88.72	101.12	132.77	July	99.62
Feb.	85.79	101.12	131.27	Aug.	100.31
Mch.	88.11	101.12	125.70	Sept.	101.12
Apr.	95.35	101.12	119.56	Oct.	101.12
May	99.50	107.23	102.69	Nov.	101.12
June	99.50	110.50	90.84	Dec.	101.12

COPPER

Prices of electrolytic in New York, in cents per pound.

Date	Average week ending
Jan. 18	13.00
" 19	13.00
" 20	13.00
" 21	13.00
" 22	13.00
" 23 Sunday	
" 24	13.00

Monthly averages			1918	1919	1920
Jan.	23.50	20.43	19.25	July	26.00
Feb.	23.50	17.34	19.05	Aug.	26.00
Mch.	23.50	15.05	18.49	Sept.	26.00
Apr.	23.50	15.23	19.23	Oct.	26.00
May	23.50	15.91	19.05	Nov.	26.00
June	23.50	17.53	19.00	Dec.	26.00

LEAD

Lead is quoted in cents per pound, New York delivery.

Date	Average week ending
Jan. 18	5.12
" 19	5.12
" 20	5.12
" 21	5.10
" 22	5.10
" 23 Sunday	
" 24	5.10

Monthly averages			1918	1919	1920
Jan.	6.85	5.60	8.65	July	8.03
Feb.	7.70	5.13	8.88	Aug.	8.05
Mch.	7.26	5.24	9.22	Sept.	8.05
Apr.	6.99	5.05	8.78	Oct.	8.05
May	6.99	5.04	8.55	Nov.	8.05
June	7.59	5.32	8.43	Dec.	6.90

TIN

Prices in New York, in cents per pound.

Monthly averages			1918	1919	1920
Jan.	85.13	71.50	62.74	July	93.00
Feb.	85.00	72.44	59.87	Aug.	91.33
Mch.	85.00	72.50	61.92	Sept.	80.40
Apr.	88.53	72.50	62.17	Oct.	78.82
May	100.01	72.50	54.99	Nov.	73.67
June	91.00	71.83	48.33	Dec.	71.52

ZINC

Zinc is quoted as spelter, standard Western brands, New York delivery, in cents per pound.

Date	Average week ending
Jan. 18	6.00
" 19	5.95
" 20	5.95
" 21	5.95
" 22	5.95
" 23 Sunday	
" 24	5.95

Monthly averages

1918	1919	1920	1918	1919	1920
Jan.	7.78	7.44	9.50	July	8.72
Feb.	7.97	6.71	9.15	Aug.	8.78
Mch.	7.87	6.53	8.93	Sept.	9.58
Apr.	7.04	6.49	8.76	Oct.	9.11
May	7.92	6.43	8.07	Nov.	8.75
June	7.92	6.91	7.92	Dec.	8.49

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, according to quantity. Prices, in dollars per flask of 75 pounds.

Date	Jan.
Dec. 28	50.00
Jan. 4	50.00

Monthly averages

1918	1919	1920	1918	1919	1920
Jan.	128.06	103.75	89.00	July	120.00
Feb.	118.00	90.00	81.00	Aug.	120.00
Mch.	112.00	72.80	87.00	Sept.	120.00
Apr.	115.00	73.12	100.00	Oct.	120.00
May	110.00	84.80	87.00	Nov.	120.00
June	112.00	94.40	85.00	Dec.	115.00

WORLD-WIDE DECLINE IN PRICES CONTINUES

Prices are on the toboggan in every part of the world and in a large share of the articles forming international trade. Of the 75 principal articles of our import trade, for which the average import price is stated by the official records of the Government, all but four, says a statement by the National City Bank of New York, are lower in the November 1920 import record than in earlier months of the year 1920. The articles in the official list which 'refuse to come down' are news-print paper, wood-pulp, pulp-wood, and bananas.

These official figures of the average monthly import price of the principal articles entering the country are an especially valuable index of world prices. The laws of the United States, which are unique in this respect, require persons in foreign countries who are exporting merchandise to the United States to state in writing and under oath before a Consul of the United States the quantity and value of the articles being sent to the United States, or in case of the absence of such statement the Consul is required to report the shipment and state the value per unit of quantity in the wholesale markets of the country or city from which the merchandise is sent.

These valuations show the broad world average price per unit of quantity in the various articles in question, rather than that for any single country. The rubber imported, for example, represents the products of the forests of Brazil, the plantations of the Orient, and the jungles of the Congo Valley, for we draw rubber from all of those sections, and when the average import price of the entire quantity imported is determined, it pictures the world trend of prices at the place of production quite accurately.

The unanimity with which prices the world over have already 'come down' is evidenced by the fact that 72 out of the 76 articles included in the import price list show a lower valuation per unit of quantity in November 1920 than in earlier months of the year. Raw cotton, for example, is valued in the November 1920 imports at 28.7c. per pound against 69c. per pound in August of the same year; raw silk \$6.34 per pound against \$12.28 in March; clothing wool 27.4c. per pound against an average of 60.4c. in May; manila hemp \$245 per ton against \$377 per ton in July; flax \$872 per ton against \$2618 in August; cattle hides 20.6c. per pound against 33.6c. in February; goat skins 62.8c. per pound against \$1.20 in May; pig-iron \$30.60 per ton against \$95.28 in September; coffee 15.3c. per pound against 22.1c. in January; cocoa 10.2c. per pound against 17.9c. in March; fresh beef 13.6c. per pound against 17.9c. in May; and rice 5c. per pound against 11c. per pound in February.

The principal articles in the list which still fail to join in the general downward movement are news-print paper, of which the import price stood in November 1920 at 56.9c. per pound against 38.6c. per pound in January; bleached wood-pulp \$193.70 per ton against \$110 per ton in January; and pulp-wood \$15.35 per cord against \$9.96 in January. The November figures of news-print paper, bleached wood-pulp, and pulp-wood being in each case higher in November than in any earlier month of the year, while bananas still persist in their upward movement, standing in November at 51.3c. per 'bunch' against the former high record of 50.9c. in March.

MONEY AND EXCHANGE

Foreign quotations on January 25 are as follows:

Sterling, dollars:	Cable	3.80
	Demand	3.81
Francs, cents:	Cable	6.95
	Demand	6.98
Lire, cents:	Demand	3.65
Marks, cents		1.77

Eastern Metal Market

New York, January 19.

There is very little change in most of the markets. The tone is generally optimistic except in zinc.

Copper demand has not improved but prices are a little firmer. If anything.

Values in the tin market have softened considerably, due to a decided slump in London.

While demand for lead has quieted down, prices are a little stiffer.

There is no life to the zinc market and little alteration in prices.

Antimony is slightly lower.

In the zinc and tin markets the matter of a tariff has been prominently brought forward in the last week.

IRON AND STEEL

With slightly better demand, with here and there a concession from the general price-level, and with the average of mill operations somewhat less, the steel trade finds nothing significant in current developments, says 'The Iron Age'. In all lines consumers expect lower prices, but recognize that time is a prime factor and that the readjustment is only in its early stages.

It is expected that certain independent mills which have operated at a lower percentage of capacity than others since the first of the year will have enough orders to make a better run for a fortnight, which in turn will be followed by another quiet period. Neither from jobbers nor from manufacturing consumers are orders coming indicating more than perfunctory filling-in, pending real developments on the price question.

Generally the leading independent companies have been running at 20 to 30% capacity.

The trend of pig-iron prices is still downward and whenever the market has been tested lower quotations have been made.

COPPER

In some quarters foreign sales of copper are pointed to as the brightest feature of this market. This is perhaps unduly emphasized because interests outside the Copper Export Association have made fair sales. In general foreign demand is reported by others as no better than for some months and this applies probably to the leading sellers to foreign countries. The general market is still very quiet so far as domestic business is concerned, but the situation is described by a leading interest as a little firmer with quotations for electrolytic at 13 to 13.25c., New York, for prompt and early delivery and at 13.25 to 13.50c. for first quarter. The levels for Lake copper are 4c. above these for electrolytic respectively. Higher exchange has been a factor in the foreign demand for copper.

TIN

The news feature in this market was the appearance last week of William Lobb, of the American Smelting & Refining Co., before the Ways and Means Committee of the House advising a tariff of 10c. per pound on pig-tin and of 16c. per pound on tin in ores and concentrates. This is figured out to mean a protective tariff for American refined tin, made from imported ores, amounting to 4c. per pound. Opinion in the trade is by no means favorable to such a measure and some ridicule of it is voiced. As cited a week ago American refined tin constitutes 22% of the tin delivered into consumption in 1920 against 6.4% in 1916. The week in the market has been a quiet one. There has been some business done each day among dealers, but consumers are conspicuous by their absence. They are evidently well stocked and their business in finished tin products is not rosy. Monday

and Tuesday of this week have been featured by decided slumps in the London market, all positions going to levels lower than since last April. This has been possibly caused by an unconfirmed report that the Malay government has reduced its minimum price from £237 to £230, but there may be political, speculative, or other causes. Despite the strength in exchange, prices in New York have declined to 34.75c. for spot Straits yesterday against 38.75c. a week ago. Yesterday London quotations were £180 10s. for spot standard, £185 10s. for future standard, and £196 for spot Straits. Arrivals thus far this month have been 825 tons with 2240 tons reported afloat.

LEAD

The outside market has been in the last few days firmly established at 4.85 to 4.90c., St. Louis, or 5.12½ to 5.15c., New York. Sales have been made at these and lower levels and it is acknowledged that a considerable business has been done. Just now the market is quieter. The leading interest has not yet changed its quotation from 4.75c., New York and St. Louis, though it was expected it would before this. It is perhaps restrained from doing so because of the import possibilities if this market is forced. It is understood to be taking but little if any business at the price prevailing at present.

ZINC

The feature of interest has been the advocacy by the zinc interests before the Ways and Means Committee of the House of a higher tariff on zinc, not only on the metal but on ores and on zinc sheets. It is claimed that foreign spelter can be sent to our seaboard at less than 6c. per pound, duty paid, which is now 15% ad valorem, while the present cost of producing spelter in this country is around 8c. Just what it now costs the Germans to make zinc is not clearly ascertainable, but competition from that source is feared. At present demand is almost nothing and quotations for prime Western are nominal at around 5.55c., St. Louis, or 6c., New York, for early delivery. Producers are not quoting future positions, but imported metal is quoted at about 5.65 to 5.70c., seaboard, for February-March.

ANTIMONY

Wholesale lots for early delivery are slightly lower at 5.15c., New York, duty paid, but the market is not active.

ALUMINUM

Virgin metal, 98 to 99% pure, is quoted by the larger producers at 28.30c. per pound f.o.b. producer's plant, for wholesale lots for early delivery, but in the outside market the same grade is quoted at 22½ to 23½c., New York.

ORES

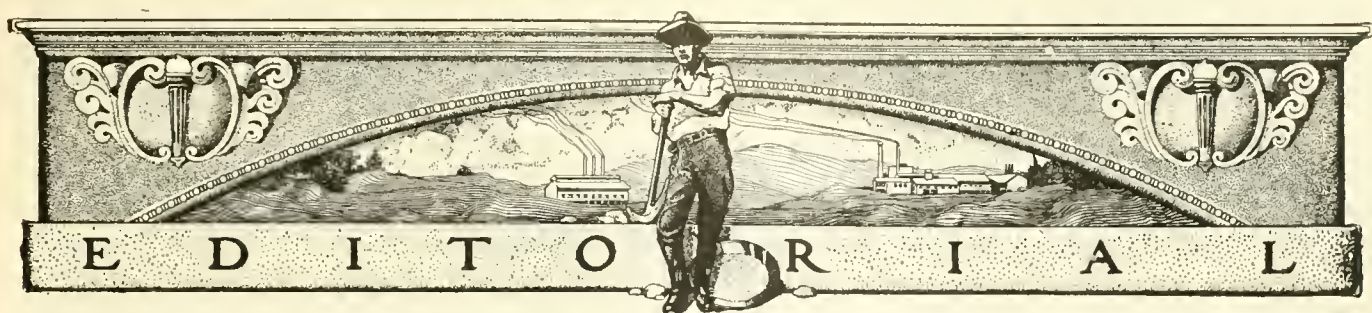
Tungsten: The market is weak. There have been offerings of European and Chinese ores as low as \$2.85 per unit. Higher exchange holds the price around \$3.25. A little spot business is reported but large consumers are not buying.

Molybdenum: The market continues quiet with quotations nominal around 50 to 60c. per pound of MoS₂ in regular concentrate.

Manganese: There are no developments and demand is negligible with quotations nominal at 35 to 40c. per unit, seaboard.

Manganese-Iron Alloys: Demand for ferro-manganese and spiegeleisen is light. From first hands ferro-manganese is quoted at \$110, basis seaboard or delivered, depending on whether it is British or American alloy. Re-sale material is held at \$90 to \$95, delivered. Spiegeleisen has sold in small lots at \$40 to \$45, furnace, but demand is light.

Ferro-silicon, 50%, is quoted by practically all producers at \$95, delivered.



T. A. RICKARD, . . . Editor

WE take pleasure in announcing important changes in our editorial staff. The Editor now enjoys the valued co-operation of two Associate Editors, Messrs. Arthur W. Allen and Arthur B. Parsons. A little more than a year ago Mr. Parsons came to us from Montana, where he had been working as engineer on the staff of the Butte & Superior Mining Company. He is a native of Utah and a graduate of the Utah School of Mines. Our readers have already made his mental acquaintance by means of the special articles contributed by him recently and they will be glad to learn that he is finishing a series of articles on the history and operations of the Nevada Consolidated Copper Company. Mr. Allen has just arrived from Chile by way of London and New York. He was born at Plymouth, England, and was graduated from Cambridge. Since then he has engaged in travel, mineral exploration, and management in many countries, including the United States, Australia, Mexico, Uruguay, Rhodesia, Argentina, and Chile. He leans to the metallurgical side of mining engineering and has won a place already as an author on ore-dressing.

IT is proposed to bring coal from Spitzbergen to Canada. The suggestion makes a call upon one's knowledge of geography. The coal will be brought by sea around the southern end of Greenland, across Davis strait, to James Bay, a southern pocket of Hudson's Bay, thence by rail to Lake Nipissing, and from there by canal-boats to Lake Huron, and so to the market. Spitzbergen now belongs to Norway, we believe, as it should, that country being the nearest neighbor.

HOW gold comes and goes on the ebb and flow of the tides of commerce is suggested by the imports and exports of the standard metal. In 1920, according to the Federal Reserve Board, the stock of gold in this country was increased by \$106,600,000, as against a net loss of \$291,700,000 in 1919. Imports of gold amounted to \$428,700,000, while exports were \$322,100,000. Of the imports, no less than \$274,000,000, equivalent to 64% of the total, came from Great Britain, whereas of our exports 60% was consigned to Asiatic countries.

FURTHER legislative action in favor of claimants under the War Minerals Relief Act is indicated by the passage of a resolution in the Senate calling upon the Secretary of the Interior for detailed information con-

cerning operations under the Act. Senator Robinson, of Arkansas, who introduced the resolution, stated that a construction had been placed upon the law that has the effect of denying most of the claims presented and he desired the further information in order to remedy the miscarriage, if the Senate thought it desirable to take further steps.

NEW MODDERFONTEIN, the world's premier gold mine, on the Rand, produced 968,500 tons of ore, yielding 499,786 ounces of gold, in the twelve months to June 30, 1920. The value of the gold was £2,555,466 and it cost £1,061,622 to produce it, so that the operating profit was £1,493,844. Of this profit £460,000 was due to the so-called premium on gold. The working cost increased to 21s.11d., say, \$5.25, per ton, as against 20s.2d. in the preceding fiscal year. The reserve of ore underground is estimated at 8,869,700 tons averaging 8.4 dwt. per ton over a stoping-width of 67 inches.

NORMAL business is predicted for April or May, and the prophet is no less a person than Professor Charles J. Bullock, chairman of the committee on economic research at Harvard. This committee has done work that commands respect and confidence, so we take the prediction seriously. The same authority says that we would have suffered the worst panic in our national history but for the Federal Reserve system and the fact that Europe was our debtor to the tune of fifteen or twenty billions. Professor Bullock concludes that "we now appear to be in the last phase: liquidation of retail prices and labor".

REFERRING to the proposed bonus to ex-soldiers and other efforts to assist those who did their duty during the War, we note a good deal of false sentiment, as, for example, the custom in the daily press of mentioning every man that wore uniform as "a hero of the world war" or "a war veteran", even when he is under arrest for crime. Meanwhile we note the large number of able-bodied young men behind cigar counters and shoe-blackening stands, all of whom could be spared for more virile jobs, leaving a place for crippled soldiers. It seems to us that the cigar-stands of California should be set aside as employment for invalided soldiers, because they call for no physical strength and no particular knowledge of the goods sold. Most men choose their own cigars. If the talk about helping "our heroes" that are disabled were

sincere, it would be possible to find plenty of jobs for them and to send a large number of husky idlers to real work, instead of allowing them to hang around and play small politics in our cities.

SINCE 1792 the United States Mint has coined 3427 million dollars worth of gold pieces. The Treasury holds 250 million as coin, 400 million is accounted for by the gold-settlement fund of the Federal Reserve Bank, and 500 million is in current circulation. The remainder either has been melted for use in art-work and for industrial purposes, hoarded, lost, or re-melted by the Government into bullion. American eagles and half-eagles are a favorite form of gold for the manufacture of the jewelry with which millions of Chinese decorate their persons; but probably the greater part of the unaccounted two billions has been re-melted at the Mint.

OIL produced in all the countries of the world last year amounted to 650 millions of barrels, as compared with 551 millions in 1919 and 514 millions in 1918. Of this increase, 70 millions is credited to the United States and 60 to Mexico, their joint increase being offset in part by the decreased output of the European oilfields. The combined production of the United States and Mexico was 590 millions of barrels, or about 90% of the world's total. Of Mexico's production, 105 million barrels was exported to the United States, so that 555 million barrels, or 85% of the world's output, was marketed in this country.

NONSENSE often masquerades as wisdom, especially in economies. We read in a report of the well-known Vickers company in London that the chairman, Mr. Douglas Vickers, said the wages paid during four years amounted to 46 millions of pounds sterling, whereas the dividends amounted to only 5¼ millions. "that is", added Mr. Vickers, "the workmen received about nine times as much as the shareholders. . . . We have, however, good hopes for next year". We have read similar comparisons elsewhere: they mean apparently that the return on capital invested should be much larger in comparison with the wages paid to the workers. In all such glib statements it seems to be overlooked that wages represent compensation for work performed and that most of the sum is spent in the cost of living. The real question is not whether the workers received more or less proportionately than the shareholders, but did the wage-men perform their work efficiently, that is, honestly and sincerely. If they did, then they deserved what they received. A profit of 5¼ on an expenditure of 46 represents 11½%, which is not bad during a period when the lives of good men were being sacrificed freely for a great cause.

PULVERIZED coal will be introduced as a fuel in the metallurgical plants of the Michigan copper industry within a couple of months. The plant nearing completion at the Michigan smelter of the Calumet & Hecla company will be the first of its kind in that region, but its successful operation will, we presume, be followed by

the general use of pulverized coal. The fuel bill of the copper companies is immense and the increased cost at the coal mines has made the need for economy more pressing. A saving of 35% in the coal consumed has been obtained at other plants and this doubtless can be duplicated in Michigan. The advantages of firing with powdered fuel, aside from the more complete and efficient combustion, are ease of regulation, and flexibility and convenience of operation. The heat units in a ton of coal can be applied where they are wanted, instead of being dissipated in the atmosphere. It is estimated that 16,000,000 tons of coal was pulverized in the United States for use in sundry industries during 1920. The manufacture of portland cement, the iron and steel industry, and the smelting of copper and lead ores account for most of this consumption. At smelters the firing of reverberatory furnaces with powdered coal has been practised for a decade, while more recently a plan has been successfully developed for replacing a large proportion of the coke in the blast-furnace charge by using pulverized coal. At the United States company's smelter at Midvale a particularly effective method of introducing the coal in powdered form at the tuyere-zone of the lead blast-furnaces is employed, the ingenious mechanical equipment being devised by members of the smelter staff. Thus far comparatively little has been done toward operating steam-boilers for the generation of electric power with pulverized fuel; but in plants sufficiently large to justify the rather costly pulverizing equipment, the economy should be important. Rapid expansion in this respect may reasonably be expected. Until recently it was believed that only bituminous coal, with a high volatile content, was suitable for use in pulverized form. However, experiments on mixtures of Western bituminous with other grades of coal have demonstrated the possibility of utilizing anthracite culm, low-volatile bituminous, sundry grades of anthracite, and even coke. We understand that a practicable scheme for using steel tank-cars, for distributing the fuel after it has been pulverized, is being perfected, so that the comparatively small consumer may purchase by the earload exactly as he obtains fuel-oil today. The equipment at his plant would then consist only of the blowers, feeders, and mixers, in addition, of course, to the burner itself, which is ordinarily a simple iron tube into which the dust is injected from a small nozzle in a current of low-pressure air.

THE State Department at Washington and, we understand, the British and French authorities, have invited the attention of the Mexican foreign office to the recent decision of the Supreme Court of Mexico denying relief to the Compañia Minera de Naisa in the litigation whereby the company sought to have reversed the decision of the lower courts awarding the ownership of the rich Maravillas mine in Chihuahua to the heirs of D. Santiago Stopelli, one of the original owners of the property. The interest of the foreign governments lies in the fact that much of the stock in the company is owned by American citizens and British subjects. Apparently pub-

lie opinion in Mexico is not unanimous as to the equity of the recent ruling; the current number of the 'Boletín Financiero y Minero de México' concludes an article apropos of the subject with this remark, as translated by our correspondent in Mexico: "The affair has reached such a delicate point as to make everyone believe that there will be a re-consideration of the decision of the Supreme Court, in all lights defective according to general feeling". This journal gives a review of the history of the mine, the salient points of which can be summarized: Stopelli and D. Saturtino Gonzales, both now deceased, formed a company in 1896 for the purpose of exploiting the Maravillas mineral land. Thereupon they enlisted financial aid from Señor D. Aurelio Corral and others. It seems that Stopelli failed to provide his portion of the capital required and his shares were divided among the other stockholders, apparently without his receiving any compensation for the one-quarter interest that he held originally. Six years later, when ore was discovered and the property became valuable, the heirs of Stopelli started suit to recover a quarter interest in the mine; however, a compromise was reached and the heirs accepted \$30,000 in full satisfaction of all claims, this transaction being duly entered in the public records. Subsequently still richer ore was found and the company prospered to such an extent that the shares were valued at thousands of pesos. In 1918 the present litigation was commenced, the heirs of both Stopelli and Gonzales seeking to recover not only the mine but the operating profits that had accrued during a period of 22 years. In the naive words of the translator of the article already quoted, "to support this new claim, the claimants allege defects in the constituent instrument [referring to the organization in which Señor Corral and his friends participated], and allege many other reasons, which may be esteemed only by those who frame codes, but which divert entirely from the direct and logical line of the facts"; all of which seems to suggest the perversion of justice by technicality, a deplorable practice, we confess, by no means confined to Mexico. The latest advice is to the effect that President Obregon has undertaken a review of the whole affair.

The Reparations

The amount of money that the Supreme Council of the League of Nations has condemned Germany to pay in reparation is staggering: fifty-three billion dollars; more than twice the amount of our National Debt and not much less than that of Germany! To it is added a 12% tax on exports. Surely the penalty is excessive, says our first thought. Whether it be more than she can pay, it is for others better informed on economic conditions in Germany to say. The average man cannot consider the subject without mingled feelings of pity and resentment. We remember that when Germany defeated France in 1871 she imposed an indemnity three times the amount she spent in that war; and it was not reparation, but indemnity, because the war was fought on French soil, like the last. So long as they were victorious the Germans

expected their victims to pay the cost of their onslaught upon civilization; as late as the spring of 1918 their Secretary of the Treasury stated that the Allies would have to pay the bill. Said he: "We will compel them to drag the chain for a hundred years". At the Armistice the German representatives agreed to do several things: one was to return the French military flags captured in 1870; instead they burned the flags. They agreed to surrender their fleet; instead they sank it at Scapa Flow. They agreed to cut down their army to 100,000, and they have 600,000 armed men at this time. They have broken their word right and left. Nor do they show any signs of regret or repentance for the horror they brought upon the world, they—not only their government, which has changed several times, but also the people, who remain unchanged—only regret their failure. Their children are starving by the thousand and American relief has been organized to feed them. We do not war with children, although we have made no peace yet with the German government. The wrong done France, and to Servia, calls for redress; it calls for justice; but it is supremely difficult to be just without doing violence to the instinct of humanity. If the Germans had shown signs of repentance; if they had given assurance of their sincere repudiation of the piratic policy of their Prussian leaders, it might be easy to be generous. As it is, we expect that those in whose hands lies the fixing of the terms of reparation will impose all "that the traffic will bear" that is, as much as Germany can pay and yet live. It is horrible; but so was the crime that plunged the world into four years of horror. It is well that war should be made unprofitable to all concerned, victor and vanquished alike.

The Guggenheims and the Smelting Industry

The public controversy between Mr. Karl Eilers and the directorate of the American Smelting & Refining Company provokes an inquiry into the origin of the so-called smelter trust and of the Guggenheim family, with which the smelting corporation is so closely identified. The Guggenheim story is typical of the success of able and energetic men in a commonwealth that aims to give an equality of opportunity to all its citizens, even to those newly arrived from overseas. The story starts with Meyer Guggenheim, a poor immigrant boy who came to Philadelphia from Switzerland in 1847. On board ship he made the acquaintance of an immigrant girl, Barbara Myers, who became his wife, and the mother of seven sons, all of whom played a noteworthy part in American industry. Meyer Guggenheim started as a vender of Swiss lace and other textile fabrics. His first participation in mining is said to have been due to an accident. In 1880, by which time he had become affluent, in consequence of innate ability and shrewd use of the chances offered by his adopted country, he obtained part ownership in a mine in Colorado by means of a note of hand on which a friend had been compelled to default to him. The mine was the A. Y. & Minnie at Leadville. According to a more circumstantial version, he was drawn into

this mining venture by C. H. Graham, a Philadelphian, who in 1879 bonded the A. Y. and Minnie claims. Graham had a partner, also from Philadelphia, named George Work; together they obtained a bond on a half-interest in the A. Y. and on seven eighths of the Minnie property. This bond was for \$8000 and fell due in October 1879. Graham contributed his share of the money needed, but Work was unable to do so and two days before the expiration of the option he relinquished his part of the deal, whereupon Graham made haste to find someone from whom he could borrow the sum necessary. He met Meyer Guggenheim on the street and asked him to lend him the \$4000, to which Guggenheim replied, "If the mine is no good, you will not be able to repay me". Graham had to acknowledge that this was true; whereupon Guggenheim said, "All right, I'll take Work's half-interest, and then if the mine is a failure you won't owe me anything". The money was telegraphed to the Carbonate National Bank, enabling Graham and Guggenheim to complete the deal forthwith. The remaining holdings in the property were held by Samuel Hirsh, of Leadville; the three owners co-operated harmoniously and profitably until the mine-workings passed from the oxidized into the sulphide zone, when the lower grade of the ore, its refractory character, and the high charges for smelting put a crimp in their profits. Disagreement ensued, and Hirsh was asked to set a price at which he would either sell his share in the property or buy theirs. He placed the figure of \$50,000 on his holdings, whereupon Graham and Guggenheim promptly accepted his offer and became sole owners. This was in 1885. They are said to have made more than \$2,000,000 out of this venture. Guggenheim was a man intensively acquisitive of information, keenly observant; he noticed the heavy charges levied by the smelting companies and concluded that this was the better part of the mining business. At this time he had sent his fifth son, Benjamin, to the mine at Leadville in order that he might familiarize himself with its affairs and look after the family interest in the enterprise, which was managed by Graham. Benjamin became acquainted with Edwin S. Holden, who was then at the head of a small smelter, named after himself, at Denver. In 1887 Holden, Arthur Chanute, Malvern W. Hles, and Richard Cline had built this lead-smelting plant, with the backing of Dennis Sheedy and Charles B. Kountze, local bankers. Holden gave Benjamin a position in the office of the smelter and used him as an agent to persuade his father to purchase a block of stock in the company, thereby raising the additional capital that was much needed just then to put the business on a sound basis. Thus Meyer Guggenheim obtained his first foothold in the smelting industry of the United States. Within a year internal dissension caused him to buy Holden and Cline's shares in the Holden Smelting Company, which was then re-organized as the Globe Smelting Company, with Dennis Sheedy as president and general manager, the other principal stockholders being Meyer Guggenheim, Kountze, Hles, and Chanute. Meanwhile Benjamin had maintained his association with Holden

and Cline, and, with his father's financial backing, joined them in building the Philadelphia smelter at Pueblo in 1889. Benjamin devoted all his time to this undertaking and persuaded his brothers to join him. At this period four of Meyer's sons, namely, Isaac, Daniel, Murry, and Solomon, were engaged in their father's lace business at New York and Philadelphia. Upon Benjamin's insistence that there was more money in producing bullion than in manufacturing lace, they decided to make the change and went to Colorado to familiarize themselves with the new undertaking. The father had succeeded so well in his lace business that he did not care to attend to his smelting interests, which he transferred to his sons under the name and title of M. Guggenheim's Sons, but he continued to be a member of the firm for many years thereafter. He died in 1905. The seven sons, in order of age, were Isaac, Daniel, Murry, Solomon, Benjamin, Simon, and William. All of them, in due course, became participants in this great industrial adventure. The leadership was taken not by the eldest son, Isaac, but by the second, Daniel, who proved himself a man of remarkable energy and sagacity. The brothers decided to extend their operations into Mexico and in 1890 they built a lead smelter at Monterrey and five years later a lead and copper smelter at Aguas Calientes. They now had three plants, producing lead bullion and blister copper, so they decided, in 1896, to build a refinery at Perth Amboy, in New Jersey. Up to this time the only mines they owned were the Tepezala, near Aguas Calientes, and the Reforma, near Monterrey. Later they secured a lease on the Encantada mine in the Sierra Mojada. They were now an important smelting consolidation and were rivals of the first big smelting combination, namely, the one identified with the Omaha & Grant Smelting & Refining Company, the leaders of which were Guy C. Barton and E. D. Nash, of Omaha, together with Edward Eddy, W. H. James, and James B. Grant, all of Denver. In 1897 this group had bought the San Juan smelter at Durango and they were working in harmony with A. B. Hanauer of the Hanauer smelter at Salt Lake City. They owned a smelter at Denver, and both a smelter and a refinery at Omaha. The Guggenheims were a thorn in their side, chiefly on account of the business done by the Philadelphia plant, at Pueblo. On April 4, 1899, a comprehensive consolidation was effected in the name of the American Smelting & Refining Company, under the leadership of Nash, of the Omaha & Grant company, and of Barton Sewell, president of the United Smelting & Refining Company, which owned the National refinery at South Chicago, a lead smelter at East Helena, and the Great Falls smelter. Another influential man was August Meyer, who brought the Kansas City Smelting & Refining Company into the combination, this last company owning smelters at Kansas City, Leadville, and El Paso. In addition there were included the Globe smelter at Denver, the Pueblo and Colorado smelters at Pueblo, the American and Bimetallic plants at Leadville, the Pennsylvania and Germania smelters at Salt Lake City, and the two plants of the

Aurora Smelting & Refining Company, one in Illinois and the other at Leadville. The chief factor in bringing this big deal to a consummation was Frank A. Underwood, who was backed by the brokerage firm of Moore & Schley, in New York. The new corporation became known at once as the 'smelter trust'; it was regarded by the mining industry as a menace that could only be mitigated by the competition of the Guggenheims. The A. S. & R., as the 'combine' was called, asked the Guggenheims to 'come in', offering them \$11,000,000 for their properties, but they demurred to the prospect of playing second fiddle. The truth is that the smelting consolidation, like most affairs of its kind, included a large proportion of dead wood. Of the many smelting plants embraced in the deal, only three or four were earning any appreciable profit, several were losing money, and their owners were in a tight place. As soon as the consolidation was effected, there was a desire on the part of sundry big stockholders to realize upon their holdings, and to do this conveniently it was imperative that the control of the Western smelting industry be made complete by including the Guggenheims, because the merger would warrant the boosting of the shares and the unloading of them on the public. All this was done in due course. The negotiations with the Guggenheims were continued until finally they agreed to accept one-third of the stock in the American Smelting & Refining Company in exchange for their properties; but in the meantime they had purchased, on the open market, somewhat over a sixth of the stock of the company, so that they controlled over a half; and at the first stockholders' meeting, instead of the American Smelting & Refining Company swallowing the Guggenheims, as the newspapers reported, it was found that the Guggenheims were in the saddle and had absorbed the American Smelting & Refining Company. In 1902 the Murray plant at Salt Lake City was completed, taking the place of the Germania, which was dismantled. Some competition still survived on the Pacific Coast, so in 1905 the smelters at Selby, near San Francisco, and at Tacoma, Washington, were acquired in the name of the American Smelters Securities Company, a subsidiary of the A. S. & R. formed at that time as a means for facilitating the expansion of Guggenheim activities. This Securities Company built the Garfield smelter in 1906 and acquired the Velardeña property in Mexico from Guy Barton and James Mathews; it also enabled the Federal Mining & Smelting Company to unload itself, bringing the Everett smelter, which was useless, into the combination. Thus the Guggenheims added the Velardeña and Tecolotes mines to their string. This acquisition of mines by the smelting people was viewed askance by mine operators because through their control of the ore-market the Guggenheims and their associates could make or mar the profitability of a mining enterprise. They were charged with abusing their power, but it is fair to say that we believe the imputation to be untrue. On the other hand, it is safe to say that the Guggenheims would have fared better in reputation if they had stuck to the custom-smelting business instead of branching out as pro-

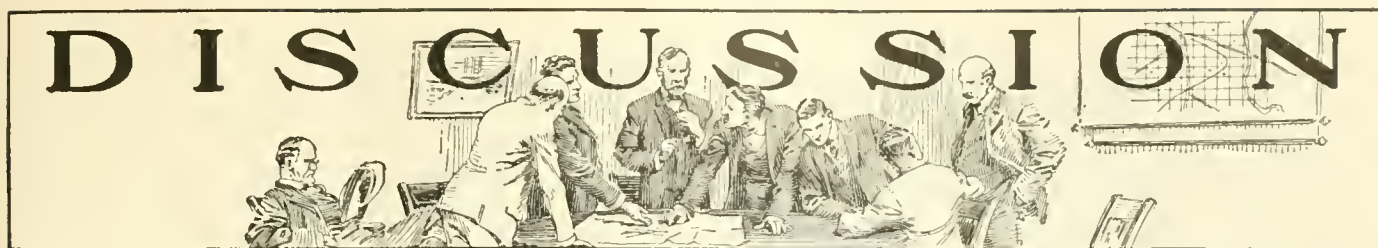
motors and speculators. Their early success was due, as is usually the case, to the personal character of the men at the head. Of these, Mr. Daniel Guggenheim was chief; he showed remarkable ability and good sense, and he seems to have won the support and co-operation of men of the highest character. The success of the Philadelphia smelter must be attributed in large part to August Raht, a fine metallurgist. The success of the Aguas Calientes smelter and other Mexican operations is credited to Mr. Morse. When the big consolidation was made the Guggenheims acquired the technical services of a notable group of men, including Anton Eilers, the father of lead smelting in the West, who had been identified with the Colorado smelter at Pueblo. With the other smelter at Pueblo they took Mr. William J. Hamilton, one of a remarkable trio of metallurgical brothers, and Mr. W. H. Howard, who is still one of their most valued technicians, as he is one of the most honored men in his profession. With the Perth Amboy refinery they secured the services of Mr. Arthur L. Walker, now professor in Columbia University and a technician whose skill is by no means academic. At the Colorado smelter, at Pueblo, they found Mr. Arthur S. Dwight, the co-inventor of the well-known sintering furnace and a professional man of the highest grade. To these may be added Franklin Guiterman, of Denver, who had mastered the economic phase of Western smelting and was particularly well informed in regard to the sources of ore-supply. Other notable metallurgists in their employ at the time of their early dominance were Charles Livingston, Robert D. Rhodes, George B. Lee, Frank Rhodes, T. S. Austin, H. S. Mulliken, Herman Garliehs, Walter Page, Eugene B. Braden, Frank M. Smith, and Karl Eilers, of course, besides E. P. Mathewson, whom they dismissed in 1901 only to re-engage him in after years, by which time he had made a magnificent reputation at Anaconda. Mr. Edgar Newhouse was with the Philadelphia plant as an ore-buyer and he has remained with them ever since, becoming one of the most important men in the organization. Their ore-purchasing department owed much to Mr. Henry Lyne, now retired, who came to them with the Globe smelter, and Mr. H. R. Wagner, who did valuable work in Mexico and South America, and is still an important member of their staff. It is entirely proper, and necessary, to record the names of these men, because without them the Guggenheims would have been nowhere; it was to Mr. Daniel's ability to hold such men that the smelter octopus owed its very life and prosperity. He was willing to pay heavily for experts and he was able to promote cordial co-operation between them and the directors, particularly his brothers, some of whom were by no means as large-minded as himself. In 1916 the firm of M. Guggenheim's Sons was succeeded by Guggenheim Bros., but the change did not synchronize with any increase of fraternal solidarity; on the contrary, it appeared to be one of the results of a suit brought by the youngest brother, William, against his brothers on account of alleged unfairness in the division of the Chuquicamata profits. The new firm of Guggenheim Bros. included only five, for

Benjamin had gone down with the 'Titanic' in 1912 and William was excluded. Benjamin organized the Power & Mining Machinery Company, which bought out the Holthoff Manufacturing Company of Milwaukee and is now one of the constituent companies of the Worthington Pump & Machinery Corporation. He was associated with Messrs. C. E. Finney, Leon P. Feustman, and Cyrus Robinson, of whom only Mr. Feustman remains with the pump company. At the date when Guggenheim Bros. was organized, Daniel was an elderly man, for he was born in 1854; in 1919 he retired and his younger brother, Simon, was pushed into his place as president of the company. Mr. Simon had been long connected with the smelting business of Colorado in particular, and in 1906 he was elected Senator from that State by methods of the crudest kind, provoking derision even among hardened politicians. Unlike his predecessor in office, he had formed strong personal likes and dislikes for members of the A. S. & R. organization, therefore his accession to office was emphasized promptly by a 'shake up', in the course of which several gentlemen found it convenient to make an exit, including the late Judd Stewart, who had created the company's accounting system and was a man generally esteemed. At the same time Messrs. John K. McGowan and Willard S. Morse resigned, as well as Mr. Karl Eilers, with consequences that still echo in the financial firmament.

The third generation has come into the business during recent years. Of Mr. Daniel's sons, Harry is the only one now with the firm; he and Edmund, a son of Murry, are on the executive boards of the Chile Copper Company and the Kennecott Copper Corporation. These young men, of course, were bred amid conditions absurdly unlike those that had helped to develop the thrift and initiative of the founder of this commercial dynasty: they climbed into the circles of *haute finance* and cherished social ambitions, which may be said to have found suitable expression in the marriage, last December, of Mr. Solomon Guggenheim's daughter to Viscount Stuart, the son and heir of the Earl of Castle-Stewart, the sixth in the title.

One phase of the Guggenheim operations we find it difficult to disentangle, namely, the interplay of the subsidiary corporations that they formed for the purpose of their financial operations outside the custom-smelting business. The Guggenheim Exploration Company was formed as early as June 1899, to be dissolved in 1915. The American Smelters Securities Company was organized in 1905. Besides these there is the National Metallurgical Company of Mexico, and, of course, the family firm. By use of these four subsidiaries the controllers of the American Smelting & Refining Company promoted various mining ventures and speculated in the shares. The Guggenheims also are said to have allowed the members of their organization to play the market on personal account. Their abortive deal in a large block of Nipissing stock in 1906 simply showed how easily Capt. De Lamar could outwit them and their engineer. The Yukon Gold issue in 1908 was discredited

by their use of Thomas W. Lawson as an ally. The Cumberland-Ely affair aroused deep resentment. The Chuquibambata issue in 1913 was an example of cynical effrontery, for they sold \$15,000,000 in bonds to the public and took for themselves the \$95,000,000 in stock. The financial legerdemain by which they consolidated the Braden fizzle in Chile with the Kennecott bonanza, in Alaska, was another example of the abuse of their prestige for the purpose of what in South Africa is called 'vernukerij'. This later part of their career as a family and as a firm therefore seems to be open to grave criticism, and even ridicule. Many of the mines they bought proved 'lemons', they missed many good ones; personally they were not adapted for such dealings, although equipped hereditarily for the keen commerce of custom smelting. The original basis of their operations became secondary to the making of money through subsidiary companies and the acquirement of valuable assets for the family firm. In twenty years the holders of common stock in the American Smelting & Refining Company have received an average of less than 4% per annum, while the Guggenheims themselves have waxed exceedingly wealthy. Here we may record the fact that in 1905, soon after the Guggenheims secured control, the common stock was quoted at \$170 per share, as compared with \$29 recently. Mr. Simon Guggenheim's apologia, which we publish on another page, is by no means convincing, despite its array of big figures to indicate the gross earnings of the company. If he would give figures to show how much the common stockholders, for whom he and his brothers were trustees, have made since 1901 and how much he and his associates have made by use of the company's organization since that time, we think the comparison would be odious. The fact is, these big groups or 'interests', as they are called, constitute a sinister phase of finance. Of them it can be said emphatically as was said by Thurlow concerning the corporation in general that "it has no soul to be damned and no body to be kicked". The morale of syndicates is low; it is much lower than that of the individuals of which they are composed. Another induction from the facts is the generalization that it is easier to create super-enterprises than it is to find the super-men to run them successfully. The late Benjamin Guggenheim was smart; Mr. Daniel Guggenheim proved himself extremely able; but Mr. Simon is not the type of man one would select as the head of an immense technical-trade organization such as the A. S. & R. Again the old question arises: Are the directors trustees for the shareholders or are they only privileged speculators? It seems as if the time had come for a re-organization of the executive board of the smelting company, not in the interest of Mr. Eilers or any small group of stockholders, but in behalf of the main body of stockholders, whose property rights are many times larger than the combined shareholdings of the two groups now engaged in what may seem to be only a domestic quarrel. We hope that these inarticulate stockholders will take steps to make themselves properly heard at the annual meeting next April.



Prospecting in Canada

The Editor:

Sir—An enquiry from a young engineer, as to where he could find unprospected ground other than Mexico appeared in the 'Mining and Scientific Press' of January 8, and seemed almost an invitation to write this article. Surely it cannot be realized by American prospectors what an immense territory awaits not only prospecting, but even exploration, north of the boundary between Canada and the United States, otherwise it were difficult to account for the indifference they exhibit.

Here, within a few hours railway journey, is a land where men speak the same English tongue, with but slight variations; where the climate is eminently healthful; where the alien has the same rights as the native; where the apex law does not, happily, obtain; and where the honest-to-goodness prospector, no matter whence he comes, will find a hearty welcome awaiting him.

Without particularizing any region, it may be better pointed out that the whole 'pre-Cambrian shield', that vast territory stretching from the Atlantic verge of Labrador to the mouth of the Mackenzie, holds patches of the two great mineral-bearing formations, the Keewatin and the Huronian, and wherever these have been intruded by later granites or granite-porphyrines, indications, at least, and often much more than indications, of minerals have been discovered. Experienced men believe firmly that the Canadian pre-Cambrian has hardly been scratched, and is destined to make important contributions to the world's metallie wealth.

There must, surely, be many Cobalts, Poreupines, and Sudburys awaiting discovery. Of course, much of the aforesaid shield is hidden from view by lake, muskeg, or glacial gravel; it is not probable that the last valuable find will be made for many a century, but the prospector of today is fortunate, because the obvious exposures, the veins visible to the first practised eye viewing them, the upstanding lodes against which a man may be halted by the simple process of stubbing his toe, are mostly unstaked. Future generations may have to dig through the cover of glacial debris, they may have to drain swamps, or lower the levels of lakes to find what they seek; but as yet this is unnecessary; all the prospector has to do is to walk, or paddle, and keep his weather eye open to discover the wealth of the pre-Cambrian rocks.

This sounds easy, does it not? Yet there is a good deal to be attended to. The Canadian bush is not a region full of blood-curdling dangers. Far from it; it is a region of great calm, of almost illimitable distance; of solitude, and during five months of the year almost Arctic

cold. Accidents happen, occasionally, but usually to the tenderfoot, the man who does not know the ropes; rarely to the old hand. The means of travel are the canoe in summer and the dog-train in winter; but during the cold season prospecting may hardly be carried on, seeing that the ground is covered by a mantle of snow, and the intense frost has made gravel-beds as hard to excavate as though they were marble. Underground, however, winter-time is the better for preliminary work, as water does not give trouble and ventilation is easier to arrange than in summer.

No tenderfoot should think of taking to the bush without a 'pard' who has had years of experience, either in Canada or Alaska. Most of the fatalities that have occurred have been due to an overturned canoe, to being caught by a blizzard too far from shelter, or through running short of provisions—and a man's appetite is something phenomenal when traveling through the Canadian wilderness.

Nevertheless, the life is alluring; few healthy young men care for any other after being introduced to it under favorable auspices. Only a couple of summers ago I met a prospector, one of the best we have, who will probably soon bank a couple of hundred thousand dollars as the result of the sale of his share in the Flin Flon copper deposit, north of The Pas, and in answer to my question: "What will you do when you get all that money?" replied: "Do, why just the same as I have been doing for the past dozen years—live in this north country, and, I hope, die here."

But anyone thinking of taking my advice should secure his backing before coming, and also make sure that there is a channel open for the flotation of his find. Canadians do not as a rule, though there are, of course, many exceptions, display that alacrity in providing the sinews of war which are necessary to a campaign; there is nothing like the wealth lying loose on this side of the boundary that there is on the other, and men of moderate means are prone to look with more favorable eye upon a mortgage than a mineral deposit, notwithstanding that the latter may yield a much larger return.

Prospecting is a gamble, say what you will. It is a case of spinning a coin with the fickle goddess: "Heads I win, tails I lose," and this is, perhaps, to some natures its greatest attraction.

As to the cost of prospecting, a precise answer is impossible, so much depends upon the men; but an initial outlay of five hundred dollars for traveling expenses and outfit, and a hundred dollars apiece per month for the seven prospecting months, should be sufficient. During the winter prospectors hibernate more or less, and fifty

dollars per month from November to April ought to liquidate all bills.

One word more: Those who make a success of prospecting are they who run straight. "The Heavens are high and the Earth far off", as the Russians used to say before the debacle. The temptation to play fast and loose with backers is more than many can resist, but, putting ethics aside, it does not pay in the long run. A reputation for trustworthiness is quite as valuable to a prospector as to any bank official in the land; each is trusted with the investment of monies confided to his care in the belief that he is an honest man.

CHARLES A. BRAMBLE.

Winnipeg, January 22.

A New Type Oil-Fired Assay-Furnace

The Editor:

Sir—The rise in price, and the increasing difficulty in obtaining prompt shipments of gasoline, are causing concern to assayers in isolated districts. Five months ago the gasoline supply at the Pato mines became exhausted. It being the dry season of the year, navigation on the Nechi river was closed; consequently there was no hope for the arrival of a new supply for many weeks.

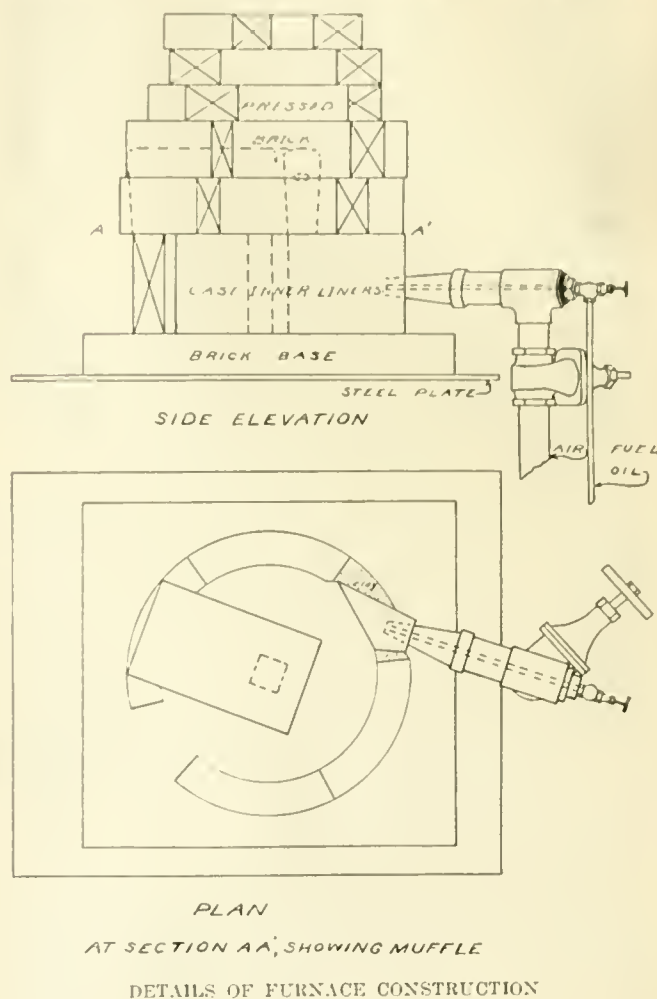
High-gravity crude-oil for the Case No. 125 melting-furnace was available, so it became necessary to devise an oil-fired assay-furnace at short notice. A two-inch pipe was teed into the 2½-in. discharge-pipe from the melting-furnace blower with a bushing. This pipe was carried 30 ft. into the assay-room, necessitating two elbows and two 'hot bends'. The burner was constructed by threading a ¾ by 2 by 6-in. home-made nozzle with short nipple into a two-inch tee. Into the opposite end of the tee was fitted a plug through which was tapped a quarter-inch pipe, extending to just short of the nozzle-tip, and protruding half an inch through the plug. A needle-valve was screwed on the protruding half-inch, fitting snugly against the plug. With the oil used, six feet of head gave sufficient pressure at the needle-valve.

The burner was tried with the same furnace that had been used with the gasoline burner; but the furnace, which was a home-made affair of brick and clay, had many cracks, and when the fire was going full tilt it resembled an aurora borealis in miniature. For a new furnace the only material available was three firebricks, plenty of pressed brick and clay, and some extra inner liners for the Case tilting-furnace. Supplies from the United States require from six months to a year for delivery, so, of course, were out of the question.

The new furnace was built to the accompanying drawings. The 'boss' is a 3 by 6-in. graphite crucible cut diagonally to fit the inside of the furnace. A hole was bored through the bottom to take the burner-nozzle. The rear of the muffle was supported by a firebrick cut in two, lengthwise. The door of the fusion-furnace was a firebrick placed on end, and the door of the muffle was made by laying a firebrick on its narrow edge on top of an extra Case liner. The two top bricks in the elevation are loose, and form the damper.

In the first trials of the furnace, feathers would not form on the cupels, although the temperature was scarcely above 'freezing'. Many experiments were made by regulating the fuel, the damper, and the ventilating orifice in the muffle. Only part success was obtained until Mr. Evans' suggestion in your issue of June 26, 1920, was tried. It was found to be the key to successful cupellation in this furnace. By cutting down the air instead of the fuel, we now feather twenty-three 1½-in. cupels in the 6 by 12-in. muffle, with the door wide open.

In a circular furnace of this type no baffles of any kind are required. Both ends and sides of the muffle show an exceptionally uniform temperature. Twelve 20-gm.



crucibles can be fused in the lower part of the furnace at one time. Regulation of the temperature is as close as with the best gasoline burner; and also as quick. The cost of operation is directly proportional to the cost of fuel-oil to gasoline, the consumption being equal.

Oil-fired assay-furnaces have a wide range of operation. With a little patience in starting, and by regulating the air until the draft is from the muffle-door to the ventilating orifice, no operator with an eye to his cost-sheet would ever return to a gasoline-fired furnace.

Pato, Colombia, August 3, 1920.

ERIC K. CRAIG.

[This letter miscarried and only reached us a few days ago.—EDITOR.]

Metallurgical Methods at Rio Tinto

Details of the Cementation Plant

By Courtenay De Kalb

*The cementation plant comprises three large areas containing 18,540,000 tons of ore; the ponds with a capacity of 5,540,600 cubic metres; and the precipitation canals, or vats.

The sulphuric-acid factory consists of four McDougall roasting-furnaces, with a capacity of 20 tons each per diem, two Glover towers of 160 cu. m. each, lead chambers, etc., for a daily production of 50 tons of acid.

On a site near-by is the smelter for the production of blister copper, containing five water-jacketed shaft-furnaces, of 250 tons daily capacity each, yielding matte running from 20 to 25% in the first fusion. In the second fusion the matte is raised to a grade between 40 and 45% copper, which is sent to the converters. The blister copper is cast in iron molds giving ingots of 125 kg., one grade running from 96 to 97%, and another from 97 to 100%. The plant at present is capable of yielding from 15,000 to 20,000 tons of blister copper.

It may be stated that the foregoing outline of the smelting plant by Señor Peña gives an impression that is in many respects erroneous, probably because he was not sufficiently familiar with smelting practice in its details to appreciate the excellent work being done by the metallurgical staff of the Rio Tinto company. Having full details myself, which unfortunately have not been released for publication, I may say that it is not the practice of the Rio Tinto smelters to make two blast-furnace fusions, as above indicated. In fact, such treatment would be prohibitive on account of the excess of iron that would have to be fluxed, calling for such large amounts of silica, which in part has to be barren on account of certain difficulties presented in trying to use the silicious ores alone. So nearly do the smelting superintendents here depend upon the sulphur in the ore for the heat-requirements of the furnaces that only 1.6% of the total charge of ore and flux consists of fuel added, this being Welsh anthracite instead of coke. Señor Peña's statement as to the grade of matte produced in the first fusion is correct, but evidently he was confused in regard to the grade of matte going to the converters. This averages a trifle over 20% and naturally this low-grade material calls for considerable expense in blowing, not only with regard to the total volume of air needed, but to the length of time required for each blow, which is necessarily long in proportion to the copper produced,

entailing greater wear and tear, and increased labor.

Another explanation would appear to be necessary in regard to the grade of the blister copper, which is quite uniform. The typical analysis is submitted in order to correct the erroneous impression given by Señor Peña.

	%
Copper	98.58
Iron	0.01
Sulphur	0.24
Silica	0.10
Arsenic	0.095
Oxygen	0.05
Gold	0.25 oz.
Silver	19.35 "

With reference to the cementation, Señor Peña's statement of tonnage in the leach-yards is substantially correct. He does not touch upon the leaching practice, since this is in no wise peculiar to Rio Tinto. Indeed, it would appear that the method is so simple, so elementary, that it is incapable of important modification. It is perfectly adapted to the Huelva ores, which does not mean that it is necessarily adapted to pyritic ores in other parts of the world. Nevertheless, skill counts in the results obtained, even with typical Huelva ores, as will appear in the following discussion.

The fundamental facts concerning the leaching of the Huelva ores are the following:

1. The leaching is accomplished by oxidation of the copper sulphides in the presence of moisture.
2. The pyrite is attacked only to a slight extent, even after 15 or 20 years exposure in the heaps. Shrinkage is rarely more than 7%.
3. Successful operation depends upon proper ventilation of the heap more than upon any other single factor.
4. The typical ore as delivered to the heaps contains from 46 to 47% sulphur, and, in the process of leaching, as a result of the removal of the copper and of a small proportion of the iron, the sulphur content is raised to a point between 49 and 50%.
5. The silicious ores, containing calcocite and almost no pyrite, yield their copper almost completely when leached.
6. The pyrite, on being lifted from the leached piles, remains massive and undecomposed, practically as it comes from the mine.
7. Coarse pyrite leaches as readily as, and yields its copper much more completely than, the fine.

8. The major proportion of the copper is leached from the piles in three to three and a half years, the metal recovered in that time being sufficient to return the total

*This article is part of a report made for the U. S. Department of Commerce. The data used are taken mainly from a paper by Javier Peña, in the Boletín Oficial de Minas y Metalúrgica of the Ministerio de Fomento, No. 3, August 1917.

operating cost of the mine and leach yards. The additional copper recovered after this period, as well as the residual pyrite (20% S), apparently represents operating profit.

The process of leaching the ore is known locally as 'cementation'. This method, in some form, has been practised from remote epochs, but never to the extent now in vogue. Richard Ford, an acute but non-technical observer, writing in 1869, makes no mention of it. The method of extraction then in use was smelting, but he does mention the fact that the waters of the Rio Tinto, which partly have their source in the Lago and San Dionysio mines of the Rio Tinto company carried copper in such abundance that it was regularly extracted. "Iron bars are placed", he says, "in wooden troughs, which are immersed in the waters; the 'cascara', or flake of metal, deposited on it is knocked off; the bar is then subjected to the same process until completely eaten away." This contains the germ of the method as practised today; it was logical to imitate Nature in leaching the copper from the ore, and the precipitation of the copper on iron was a reaction that had been known for generations.

Despite Ford's failure to report the leaching method, it is mentioned as having been employed at Rio Tinto since 1839, by Joaquin Gonzalo y Tarin in his 'Descripcion Fisica, Geologica y Minera de la Provincia de Huelva', Madrid, 1888. It may be said in passing that this is one of the most scholarly books ever written concerning the mines of Huelva, and is now exceedingly rare. The subject is also discussed at considerable length by Ramon Rua Figueroa, in his 'Ensayo Sobre la Historia de los Minas de Rio Tinto', Madrid, 1859, a work even more rare than that of Tarin. He refers to the process of cementation as having first appeared in 1752, but it seems from the records that this copper of cementation represented metal merely precipitated from the mine-waters. This was during the administration of Samuel M. Tiquet, who supplanted Liebert Wolters through successful litigation. Cementation is again mentioned in 1788 by Francisco de Angulo, but the references to it do not indicate that artificial leaching was employed, although the practice of heap-roasting and subsequent smelting in reverberatories is specifically described.

A curious discussion took place about this time regarding the properties of cementation copper, that is, copper precipitated by iron, and a prejudice against its use in the trade was created by statements that it was not really copper, but only iron colored by copper. The question assumed such importance that it was seriously discussed by eminent men of the time, and the theory of the process of cementation, or precipitation by iron, was presented with remarkable clearness and accuracy by Pedro Heury, professor of mathematics in the University of Seville, which was printed in the transactions of the Royal Patriotic Society on May 12, 1791.

The application of the modern method of extracting the copper by leaching was the result of investigations made by a Spaniard, Felipe Prieto, of Seville, who obtained a 'privilegio', or royal patent, for the process,

which was published in the Official Gazette on September 9, 1815. It was described as an original invention for "a chemical discovery for utilizing the copper-bearing pyritic minerals, no matter how low the percentage may be". Prieto was an indefatigable worker, and it must be admitted that the establishment of the process on a working basis was due to his energy and determination; but it was by no means the original discovery that he claimed. It was inevitable that the possibility of extracting the copper by leaching would have been discovered accidentally at a comparatively early period, because of the prompt reaction that occurs on exposing the ore to the elements. The earliest mention of the process was in the 15th century, and was made by the alchemist Basilio Valentin in a treatise entitled 'Cursus Triumphalis Antimonii'. It was applied on a working scale at the mines of the Lower Harz in the middle of the 16th century, and it was again described in 1640 by Alonso Barba in his work 'Arte de los Metales'. Nevertheless, it appears that these early investigators had not conceived the idea of using the simpler method as worked out practically by Prieto. They seem not to have been able to break loose from the notion of hastening the reactions by heat, and the heaps were first subjected to some degree of roasting. Barba specifies that the ore should be "burned" until the pyrite had lost its brilliancy, after which it was to be leached and the copper precipitated from the liquors by iron.

The important contribution to the technology of leaching that has freed the Huelva mines from dependence upon pyro-metallurgy, making it possible to cover the costs of operation by extracting the copper even from ores leaner than 2%, must be credited to Felipe Prieto. In reality it appears to be a process peculiarly adapted to the character of the ore found in this district, and it has not yet been determined conclusively what the peculiarity is that renders it so suitable. This can be ascertained only by investigations aided by the microscope, a study that still remains to be undertaken. No information that was based upon anything more than shrewd surmise could be obtained from any of the operators at Huelva. The results of the process are extraordinary, not alone because of the extremely high percentage of copper recovered, but because the leaching of the copper does not lead to any extensive disintegration of the pyrite. So far as my own investigation is concerned, which from force of circumstances has been somewhat hasty and superficial, it would appear that the reason may be found in the fact that the copper sulphide was introduced by mineralizing agents toward the end of the deposition of the pyrite, if not entirely subsequent to its formation. The copper appears to exist almost wholly in the form of chalcopyrite and secondary chalcocite following the parting-planes of the pyrite. Only to a slight extent is the copper held as a solid solution in the iron sulphides. There is evidence to show that, in nearly all cases, the original deposits have been subjected to pressures that developed fracture-planes, into which later metal-bearing solutions could readily have pene-

trated. There is no doubt that this has happened.

The method of leaching, as originally applied, is quite fully described by Tarin. This will be of interest to the student, but the practice today has grown far simpler, as skill in the operation has increased. Success is largely a matter of experience. The following notes are the result of information gathered from a number of successful operators in the different parts of the province of Huelva, and by personal study of the practical work, facilitated by data from the records of various plants.

In the beginning it used to be considered necessary to build the piles in a very exact manner, with impervious bottoms of tamped clay, and with carefully walled-up ventilating shafts or 'chimneys' through the pile of ore, and to regulate the entrance of air along the side by covering it with fine which could be opened up at places if desired. Careful observation of the temperature by thermometers was made at frequent intervals. Today most of this old routine is abandoned. No attention is

over the widening pile in ordinary mine-ears of 1000 to 1500-lb. capacity.

The depth of the piles is variable, starting from zero at the up-hill end and terminating below with a maximum height of 32 ft. The coarser the ore the deeper may be the pile. The fine does not afford good extraction; it yields about 50% of the copper promptly, after which the recovery is very slow, and the total extraction is most imperfect. Accordingly, care is taken in blasting at the mine not to produce much fine ore, and the run-of-mine is taken to the leach-piles, with much material as large as 12 to 18 inches diameter. This is in violent contrast with prevalent ideas as to leaching. The ideal usually sought is to ensure intimate contact with an abundance of the lixiviant, and to crush the material preparatory to leaching to a finely granular condition. This is exemplified in the old practice of vat-leaching of gold ores in the cyanide process. It was also formerly thought necessary to follow a similar practice in the



A BED OF LEACHED ORE AT RIO TINTO



SHIFT-BOSSSES OFF DUTY IN THE SOUTH PIT

paid to the character of the bottom; any ordinary soil is satisfactory; the drainage from the area is so complete as to cause very little loss that can be accredited to seepage into the ground. The topography also is a matter of minor importance. Some of the piles or 'montones' are built around steep hills having a slope as sharp as 15° to 18°. In many parts of the Province the low ground is preferred, probably because the soil contains more clay and is less pervious, but the grade then falls as low as 2° to 4°. The superintendents generally prefer a grade of about 10°. No attempt is now made to build piles of uniform shape. Large areas are covered, being extended down-grade, like a broad dump-pile, with a level surface from the tram-lines that are built on contours to facilitate distribution of the ore. In fact, the most economical transportation of the ore is a controlling factor. An ideal condition is a contour on which the tramway can be constructed and from which there is a sharper descent to ground than then flattens again. This enables bins to be built, into which the ore may be dumped from the mine-cars, which usually hold from 10 to 20 tons. From these bins the ore is then trammed

earlier attempts at the leaching of copper ores. More recently, as seen at the Ajo mine in Arizona, the ore is crushed only to about $\frac{3}{4}$ inch, with considerable coarser material going to the vats. The lixiviant penetrates these relatively large ore-particles, resulting in a complete extraction.

The cementation practice at Huelva is wholly different from this. The ore-piles are never immersed in water; they are barely wetted, and are kept wet only a portion of the time. No acid is added, since this is produced in sufficient quantity by the oxidation of the sulphur. Plain water, and also the return-liquor after precipitation of the copper, constitute the lixiviant, although at some mines the spent liquors are returned only in part, or not at all. In the beginning, no water is added. The ground is always moist from the drainage of liquor across the yard, and this moisture rises gradually into the pile; in this manner the ore absorbs the maximum that it will hold until active leaching begins. Some exudation of soluble copper-salts takes place during this initial period, for it must be noted that the ore as it comes from the mine contains sometimes 50% of its copper in the form

of sulphates, and 10% as sulphate is almost always present in the raw ore at the mine.

Fine ore is spread over the top of the piles during this period, partly to regulate the ventilation, and partly to furnish a restraining bottom for the wash water, so that it may seep downward into the ore with some degree of uniformity instead of washing through it suddenly and ineffectively. This cover of fine is then shaped into a series of low ridges bounding basins, from four to six feet square, arranged for continuous flow from one to another, the quantity of water being adjusted to the rate of seepage so that no overflow occurs from the last basin in each series. It is laid out precisely like an irrigated garden.

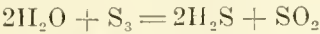
While the pile is becoming moistened from below it gradually heats from the oxidation of iron and sulphur. The temperature will rise at spots to 150°, and even 180° F., but this promotes such active oxidation of pyrite that it should be held lower. A new pile begins to heat in four to six weeks without the addition of any water from the top. This temperature is controlled as far as possible by ventilation, the draft of air through the pile being restrained and governed by the covering of fine. On one extremely large pile, covering several acres of ground, which I inspected, the temperature had risen to about 130° F., with spots from which steam and sulphurous gas were issuing, and here the rock on the surface was too hot to be touched. This pile had been begun in February and finished in April. The higher temperature was coming from the April ore. The hot spots were being tamped by fine thrown upon them, and preparations were nearly completed for the first wash. The quantity of water used was too variable to enable me to get any expression from the superintendents of leaching as to the ratio per ton of ore. After a pile has been leached for a long period it becomes less active, less liable to rapid oxidation, and requires less frequent washing. There is no stated time-interval between successive washes, this depending altogether upon the condition of that pile as to temperature. During the rainy season the piles stay wet a large part of the time, and the tendency is to over-dilute the solutions. During the summer the quantity of waste-solution to be handled is materially reduced. At one plant that I inspected, the area of heaps must have embraced about 600 acres. The maximum flow of solutions from this area, which flow is measured at a weir above the precipitation-plant, is 550 cubic metres per hour, or 13,200 cu. m. per diem (3,442,878 gal.). This amounts to a per-diem average of approximately $7\frac{1}{2}$ gal. per square foot of surface, although I am sure that the superintendent would say that any average is misleading. The flow at times drops to 380 cu. m. per hour from this same area. The ore absorbs from 3 to 10% of its own weight of water when the piles are first laid, and after leaching and drying it will take up from 10 to 12% of water.

On giving a pile its wash it always settles, but this is generally less on the first wash than on the second. Sometimes, if the temperature has crept too high, it will settle

18 inches or more, which indicates that there has been excessive oxidation, causing disintegration. The temperature follows up the incline of the heap from the lower (and deeper) edge. Thus it can be watched and gauged with considerable accuracy. Excessive shrinkage of a heap means poor management, as a rule, though in part it may be due to an excessive amount of fine in the material sent to that heap from the mine. As the tendency of the ore in certain places in the mines is to produce more fine than in others, it becomes necessary for the foremen at the mines and in the leach-yards to work in close agreement through the yardmaster to deliver coarse and fine ore in suitable proportions to the various parts of the leaching plant while building the heaps. The shrinkage cannot be expressed in volume, but by weight. As determined from some of the larger heaps, it amounts to about 17% by weight. The average through years of experience seems to be 7%, but with 3% of copper present in the ore, shrinkage will be 15 to 17%. In some places the average shrinkage is as much as 10%. This does not include mechanical losses in removing the leached pile, and in screening for market. The total losses amount to more nearly 20% of the ore laid down in the leach-yards.

Figures were hard to obtain concerning the amount of pyrite lost in the process. It would require the collection of data for a long period, with this object in view, to reach a reasonable conclusion upon this question. The average analysis of the ores compared with the analyses of leach-liquors shows that many other elements besides iron figure in the reduction of weight. For example, the zinc leaches as readily as the copper, but it does not precipitate in the vats, hence it would seem that it re-deposits on the ore. Arsenic represents a considerable amount of weight removed; as minor factors, phosphorus, tin, and lead are leached and are precipitated from the solutions. The analyses at hand are insufficient to explain what actually happens. Many of the substances dissolved build up in the return-liquor, and should continue to do so until a much higher density of solution is reached, unless there is a constant elimination of spent solution at an equal rate with the introduction of fresh water into the leach-cycle. There must, consequently, be some escape, accidental or otherwise, for the spent liquors, to account for the reduction in weight. This is rendered all the more necessary when the high rate of evaporation during the long dry hot season is considered, in which period high concentration of the solution would occur unless large additions were made, sufficient to compensate not only for loss of water by evaporation but for loss of solution rich in salts. The spent liquor is all returned to be applied as part of the wash upon the heaps. The specific gravity of the solution remains constantly near 1.1. The iron in the spent liquor ordinarily amounts to 20,000 parts per million, this including both ferrous and ferric sulphate. A large part of this iron is derived from the solution of the chalcopyrite, so that the pyrite itself, to that extent, is not robbed. Despite the fact that chalcopyrite films are easily detected in apparent

abundance on inspecting the ore by the eye, the verdict of the cementation superintendents is that the copper present is mainly in the form of 'black copper'* and chalcocite (Cu_2S), in nearly equal amounts. Cu_2S does not require the presence of iron sulphide to facilitate its solution, as it will oxidize directly. Therefore, the extraction depends upon maintaining a sufficient amount of air in circulation. If the oxygen is insufficient a reaction occurs between the water (as water vapor) and the sulphur, producing sulphuretted hydrogen, which serves as an indicator. The reaction is



The question as to what series of reactions occurs in the heap is still a matter of dispute. The chemists in charge accept the following well known series of formulae as probably expressing the phenomena that occur:

- (1) $33\text{FeS}_2 + 28\text{O} + 4\text{H}_2\text{O} = 29\text{FeS}_2 + 4\text{FeSO}_4 + 4\text{H}_2\text{SO}_4$
- (2) $4\text{FeSO}_4 + 4\text{H}_2\text{SO}_4 + 2\text{O} = 2\text{Fe}_2(\text{SO}_4)_3 + 2\text{H}_2\text{O} + 2\text{H}_2\text{SO}_4$
- (3) $\text{Cu}_2\text{S} + \text{Fe}_2(\text{SO}_4)_3 = 2\text{FeSO}_4 + \text{CuSO}_4 + \text{CuS}$
- (4) $\text{CuS} + \text{Fe}_2(\text{SO}_4)_3 + \text{H}_2\text{O} + 3\text{O} = 2\text{FeSO}_4 + \text{CuSO}_4 + \text{H}_2\text{SO}_4$ or
- (5) $32\text{FeS}_2 + \text{Cu}_2\text{S} + 3\text{H}_2\text{O} + 33\text{O} = 29\text{FeS}_2 + 2\text{CuSO}_4 + 3\text{H}_2\text{SO}_4 + 4\text{FeSO}_4$

In the opinion of some operators the amount of soluble copper (as original sulphate) in the ore as received from the mine is about 0.5% and sometimes as high as 1%. This latter would be half of the average copper-content. This unquestionably differs in different orebodies, and is to some extent dependent upon whether there is free drainage or not from the mines. If there is not, then the amount may become large. At Rio Tinto the ore from the San Dionysio mine contains largely secondary copper sulphides, and this mine has natural sub-drainage flowing into the Rio Tinto. The old Rio Tinto south lode seems to have more sulphate, and this mine apparently contributed less to the river-drainage. The chalcopyrite, in leaching, is probably removed through the solvent effect of $\text{Fe}_2(\text{SO}_4)_3$ upon that mineral. This then robs iron, to some extent at the expense of the pyrite, in becoming reduced to FeSO_4 .

The completeness of extraction is remarkable. After ten years exposure the copper is almost wholly removed. I am assured that the extraction exceeds 95%. After three years the upper six to eight feet of a pile will show an extraction of about 80% of the original copper; the next six to eight feet, 60%, and so on to the bottom. Time is an important factor in leaching. Huelsva pyrite will yield some copper after a pile has been leaching 30 years or more.

For successful leaching, alternation in the application of wash-water is a matter of great consequence. The water must be so adjusted as to descend very slowly and wet the pieces of ore, giving time for deep penetration by capillarity. It must then be allowed to dry so as to draw in oxygen to facilitate and complete the re-

actions. The removal of the copper, some zinc, a portion of the iron, with other elements, results in elevating the original sulphur-content of 46 to 47% in the raw ore to 49 or 50% in the washed ore. No difference is observable to the eye between the two. The washed ore appears as bright and fresh as when it came from the mine. Some basic iron sulphate deposits around the sides and on the top of the heap, but not on the ore within the pile.

The following analyses represent approximate averages of the solutions entering and those leaving the precipitation vats, the quantities being stated in parts per billion:

	Entrada	Salida
Ferrous iron.....	19,215	23,250
Ferric iron	1,464	none (?)



IN THE TOWN OF PUEBLA DE GUZMAN, NEAR THE THIARISIS MINE, SHOWING A GROUP OF PEASANTS

Copper	3,483	23
Zinc	1,978	2,100
Arsenic	230	78
Antimony	2.1	none
Bismuth	2.3	1.3
Cobalt	13	10
Manganese	59	118
Silica	180	268
Calcium	230	252
Alumina	539	1,003
Magnesium	284	234
Potassium	402	314
Sodium	300	228
Phosphorus	31	8
Tin	11	3
Lead	8	1.8
Chlorine	43	39
Total SO_4	59,206	55,536
Free H_2SO_4	8,582	4,260
Specific gravity	1.0820	1.0777

*The films are mainly chalcocite and covellite. The term 'black copper' seems to be misused.

Comparison of the foregoing figures with those from another large mine shows the following:

Leach-Liquor, Parts per Million

	Entrada	Salida
Copper	580	48
Ferrous sulphate	57,120	64,470
Ferric sulphate	3,020	2,140
Total sulphate	32,050	30,960

It will be seen that the analyses are differently reported. Calculating to ferrous iron, for comparison, we have 20,563 parts per million in one case as against 19,215 parts in another, in the entering solution. The low proportion of copper is noticeable. Moreover, at some plants they do not dare to return the spent liquor to the leach-piles, since basic iron salts are then deposited on the ore, resulting in a stoppage of the extraction of the copper. The average copper-content of all ore sent to the leach-yard at the Herrerías mine, for example, is 1.27%, with an average of 47.5% sulphur. In three years the copper is reduced to 0.18% (85.82% extraction), while the washed ore at that time will assay 49.5% sulphur. The heaps are treated six years, resulting in an extraction of more than 90% of the copper. At the Tharsis plant the average ore sent to the leach-yards carries 1.5% copper and 48% sulphur. After washing for six or seven years it contains only about 0.08% copper. If leached from three to five years the copper-content will run from 0.20 to 0.25%, and if the ore has been too fine and too compact in the pile the residual copper contained after five years of leaching may be as much as 0.50%.

Whether the differences mentioned above are due to differences in the character of the ore or to differences in the skill of manipulation is not always apparent. Perhaps both figure in the divergence observed. While there is no large mineral area in the world where greater uniformity in the character of the ore is seen, there are distinctions that the technologist discovers, as, for example, the ore from certain mines decrepitates more freely, while in others it is more 'free-burning' than that from other deposits. The San Telmo ore is especially celebrated for its free-burning quality.

In addition to the ordinary leach-liquors from the cementation yard, the mine-waters are always sent to the leach-system. Whereas the strong liquors contain above 3000 parts of copper per million the mine-waters usually contain no more than 600 parts. Pumps are no longer used at the mines, all types having proved expensive. Accordingly wooden bailers are employed, coated with tar and bound with copper. At the San Dionysio, as reported by Peña, two bailers run in balance, each having a capacity of two tons of water, and the daily capacity, during a bailing-period of 20 to 21 hours, is 300,000 gallons. The bailer makes a round trip from the surface to the 32nd level in $2\frac{1}{2}$ minutes.

Considerable water also comes from the Lago pit on the north side of the ridge known as Solomon's mountain. It is interesting, in passing, to note that the Lago has been an important source of the Rio Tinto, that is, the river of that name. Accordingly this ore has been

subjected by nature to nearly the same conditions as those present in the leaching plants. This mine is so low in copper that the greater part of the ore does not pay to be handled through the cementation plant; it averages 50% plus in sulphur, and is the best pyrite for acid-making produced at the Rio Tinto. The Lago pit is 1700 ft. long, 800 ft. wide, and about 500 ft. deep.

The copper-bearing liquor going to the precipitation plant invariably has a deep emerald-green color. It flows to precipitation vats, built usually flush with the surface of the ground, having concrete walls, lined with two-inch plank. The concrete is painted with asphalt. A common size of vat is 100 m. long, by 1 m. deep, by 3 m. wide. In one plant there are 3500 linear feet of vat, which includes a series of shallow 18-in. vats, that follow the deeper ones. The vats are filled with pig-iron and scrap-iron, pig-iron being used exclusively in the vats through which the solutions first flow. Both Spanish and English pig-iron are used. The grade employed contains about 92% metallic iron, and is extremely high in graphite. As the solution of the iron progresses the graphite accumulates in a layer between the iron and the crust of leaf copper, or 'cascara'. Sometimes this layer of graphite becomes a half-inch thick. The speed of the solutions through the tanks is regulated in accordance with their copper-content; a solution with a small amount of copper requires more time for precipitation. Also, the weaker the solution the greater is the proportion of fine granular copper that is precipitated. This is high in grade, containing 80% metallic copper. The spent liquor, still containing about 20 gm. of copper per cubic metre (20 parts per million), in most cases is pumped back to the leach-yard by acid-resisting pumps.

The copper precipitate is all washed over screens having about $\frac{1}{4}$ -in. perforations, the screens being 3 m. wide and 10 m. long. The leaf-copper collects on the screens, and the undersize flows to inclined washing-floors or 'planillas'. The fine cement-copper is here concentrated, giving a material that assays 90 to 92% copper, which is shipped. The tailing from the planilla, containing a large amount of graphite, goes to settling-vats. It is dug out from this vat at intervals, and, on drying, assays about 40% copper. This is mixed with enough granular copper from the low-grade solution-vats to make a 70% grade for melting. The average grade copper precipitated is usually about 70% metal. The iron consumed varies from 1.4 parts to each part of copper by weight up to 2.392:1.

This undoubtedly depends upon the proportion of ferric iron in solution, and also upon the amount of free H_2SO_4 present. It will be seen that the proportion of ferric sulphate is maintained relatively low at all the plants, which is the result of careful manipulation. The presence of too much oxygen at the time of washing a heap increases the proportion of ferric salt. The constant assertion is made by the superintendents of leaching that the critical point is proper aeration at the various stages of the operation. The importance of this control of aeration is reflected in the extremes between

a consumption of 1.4 parts of iron per part of copper by weight at one plant and the startling increase to 2.392 parts of iron at a less well regulated leach-yard.

I was unable to obtain data anywhere regarding costs, but figures given me by well-informed engineers in the city of Huelva, together with deductions from data furnished by superintendents at various plants, indicate that the cost of extraction of the copper by cementation has been approximately four cents, U. S. currency, per pound of copper recovered, and at one plant, where less than 2,000,000 tons of ore was lying in the leach-yards, the manager informed me that the cost was 0.385 peseta per kilogram, equal to $3\frac{1}{2}$ ¢. per pound. This included the cost of mining, the building of ore-heaps, leaching, and precipitation. On the basis of 2% copper in the ore, and 90% recovery, this would give a total cost per ton of ore of \$1.26. The highest cost that my figures showed at any plant was 6¢. per pound of copper or \$2.16 per ton of ore. It may therefore be accepted that the total operating cost is repaid through the copper by leaching the ore from 3 to $3\frac{1}{2}$ years, as previously stated, and the total copper recovered normally yields a profit without taking into account any returns from the pyrite. The latter is, therefore, a by-product.

No detailed mention has been made of the peculiar character of the silicious ore, which adds considerably to the economic results above outlined. The North pit, at Rio Tinto, contains a particularly large amount of this material, and it is nearly all high in copper as compared with the very basic pyritic ore. Similar material is found in many of the Huelva mines. The silicious ores represent porphyry that has been sericitized, and which contains chalcocite in proportions varying from $1\frac{1}{2}$ % copper to 9% and even 10%. The rock is bleached white, except where tinged gray from the sooty chalcocite, and it is friable and granular. In many places the chalcocite is found in seams from the thickness of a knife-blade up to a half-inch. Such ore is not mixed with the pyrite, but is stacked in separate heaps for leaching, the thickness of these heaps being less than when pyrite is used. The object is to permit free ventilation. The chalcocite oxidizes and leaches in the course of years, and, as a pile becomes depleted of its copper, fresh ore is piled on top. Thus the copper is recovered without other treatment. This ore is similar in appearance to the disseminated ores from the Inspiration, Miami, and Nevada Consolidated mines in the United States, and I am told that it will concentrate equally well by flotation, but that the methods of leaching pursued are more economical, even when the interest on the capital locked up for so long a period is taken into account. The time required for leaching such silicious ores is ten years.

Through these silicious orebodies are seams of some width that carry silver, sometimes as much as 50 oz. per ton, but more commonly 10 to 15 oz. This ore is kept apart, as far as possible, for separate treatment.

THE value of gold sold by the Gold Producers Association of Australia from February 1919 to October 1920 was \$31,908,889, and it is estimated that by the end of

1920 gold sold and exported reached a total of \$35,235,000. The bulk of the gold hitherto exported has been marketed in India, China, and Malaya, but a sale of gold, equal to about 164,700 oz., was recently made to American bankers at a price which will return to the Association \$4,646,160, yielding a premium of \$1,244,160.

Fire Hazards at Mines

Some of the following conditions are frequently found around a mine. All of them tend to increase the risk from fire. They are noted by B. O. Pickard, engineer for the Bureau of Mines.

Wooden head-frames.

Planked floors around the collar of the shaft or adit-portal.

Frame buildings in the immediate vicinity of the collar of the shaft or adit-portal, often grouped about the collar. At several mines frame buildings have been built over the shafts and adit-portal.

Mining timbers piled in the immediate vicinity of the collar of the shaft or adit-portal.

Cans of oil and gasoline standing at the collar of the shaft or adit-portal.

Boxes of dynamite near the collar of the shaft or adit-portal.

An accumulation of waste materials and refuse around the collar of the shaft or adit-portal.

Wooden snowsheds leading to the mine-portal with rooms in the snowsheds for blacksmith-shop.

Accumulation of oil, waste, and paper, in the inclined timber sets immediately below the collar of the shaft.

Pump-house and hoist underground not fireproofed; uncovered oil, waste, and cans of lubricating oil in the immediate vicinity of the pumps and underground hoists.

Accumulation of combustible rubbish, dynamite, and mine-timbers at underground stations.

Electrical apparatus not properly insulated and not placed in fireproof stations.

Underground magazines in unclean condition; boxes and papers permitted to accumulate; dynamite in working places.

Large carbide containers left open, partly filled with carbide.

Pulleys and idlers in shafts permitted to run dry and hot.

No attempt made to control ventilation.

No fire-extinguishers nor fire-hose on the surface or underground.

No self-contained oxygen-breathing apparatus.

No men trained in the use of the self-contained oxygen-breathing apparatus.

No systematic plans made for fighting fire.

No disaster signals.

No arrangements for converting the air-lines into water-lines to fight fires.

No fire-doors.

No fire inspection in the stopes.

No thought given to fireproofing shaft-collar, shaft-timbers, and stations.

Teaching Engineering Students to Write

By Homer A. Watt

*When the chairman of your Program Committee did me the honor to request that I read at your conference a paper on the general subject of technical writing, I replied that I was neither an engineer nor an editor, and that I did not presume, therefore, to instruct editors in the composition or revision of technical articles, but that as a college teacher of English who has struggled for several years with the task of making engineering students more articulate, I should be glad to tell of my own problems and methods. It is my purpose to point out first the extent to which editors of technical journals are concerned with the efforts of college teachers of English composition, then to outline the training methods which the English departments of technical schools are now following, and finally to suggest in what ways the editor may assist the teacher to solve the problem with which both are struggling, that of creating a higher standard of craftsmanship in technical papers.

The service of the teacher of composition in the technical school to the editor of the technical journal is that of the drill-master who trains the soldiers to the general who leads them into battle. It is our humble task as teachers to struggle with fogginess of thought and incoherencies of expression, and by pointing out his defects to the student so train him in habits of self-correction that the manuscripts which he submits to editors will be tolerably free from the errors that have helped to make us wrinkled and gray. Although I have no statistical evidence of the assertion, I believe that most of the contributors of the substantial articles to the technical journals have been trained in professional schools. Men so trained have a feeling of membership in the engineering profession: they see their own tasks in relation to the work of toiling engineers elsewhere, and so are eager to reach out and exchange experiences and opinions through the medium of the technical press. But skill in expression does not come with desire, and many of these men are handicapped by lack of experience in writing. An engineer told me only a few days ago of the comical agony of an expert in electrical meters who was called upon to present a paper on that subject before an engineering society. This master of electrical meters knew his field thoroughly, but the task of selecting and arranging and expressing his ideas for the understanding of others was quite beyond him.

Engineers who have not been trained in literary craftsmanship as students frequently remain incoherent and clumsy in expression for the rest of their lives. In the rush of their professional work they are too much pre-

occupied to study the art of writing; what little skill they do acquire they gain by practising on their associates, their correspondents, and the editors. The editors, cursed though they are by badly written contributions, cannot take the time to teach composition. The interest of the college teacher is in the process of training; that of the editor must be in the finished product. In revising for a New York editor a very badly written manuscript, I suggested that the author would improve under instruction. "That may be", was the reply, "but if his stuff is so rotten that we can't print it, we'll have to turn it down; we can't afford to give the man a course in writing—that is not our business." But this training in writing is exactly what the college teacher aims to give; our highest hope is that the engineering students whose 'themes' we have carefully corrected and criticized will not burden editors and others with the compositional abortions that we have struggled to put into shape.

"Is it possible to teach engineering students to write?" an engineer asked me the other day. Yes, it is possible, just as possible as to teach them mathematics and mechanics, provided we are satisfied with humble results and do not expect our students to acquire the literary finish of a Huxley. To be sure, some of our effort will be wasted; many of our students will never write because they will always lack ideas and incentive to expression. But some will think better and write more coherently for their training, and from them our reward will come. Among teachers of college English I have met those who profess to believe that all efforts devoted to teaching engineering students to write are wasted, but I have never agreed with these skeptics.

There seem to be at present three different systems or 'schools' for the teaching of composition to engineering students. These are alike in being based on analyses of essays and constant practice in theme writing, and in aiming primarily at correct and effective expression. They differ in material employed, in method of attack, and in secondary objectives. I will define and comment briefly on each.

The first refuses to give the engineering student special consideration. In universities in which the English department is in the college of arts, the engineering student is usually put through the same mill as his brother in liberal arts under the theory that he gets too little contact with cultural subjects and needs more. Where this point of view is sincere and the attitude of the instructor is sympathetic and understanding, such a process is hardly open to adverse criticism. Unfortunately, however, too many teachers of English dislike to instruct engineering students and assume toward them an attitude of academic pharisaism to which the students are quick

*A paper read at the meeting of the National Conference of Business Paper Editors, in New York, on October 21, by the Associate Professor of English in New York University.

to respond in a cordial hatred of their work in English. I do not believe, moreover, that most engineering freshmen (the course is usually given in the freshman year) can be made to see that a purely academic course in English composition has any connection with the engineering course which they insist they have come to college to take. It may be argued that the English course is good for them, and that some day they will realize its value, but if their attitude while they are taking it is negative, not to say rebellious, it is hard to see how they can get much out of it.

The second type of course, given also usually in the first year, is especially designed for the engineering student. It aims, like the first, to give him culture and training in expression, but it has also the unique aim of defining for him the profession which he is preparing to enter and helping him to think of himself and of his technical school education in terms of his ultimate service to his fellow-men. To this end he analyzes essays which define engineering and which comment on the value of the different subjects he is studying and on such big themes as the relation of science and literature and of 'practical' work and 'chamber' work; in addition he is asked to write themes based on his reactions to this reading or drawn from his personal experiences or reflections. Three collections of essays which meet the demands of this type of course have so far been edited. They are: Aydelotte's 'English and Engineering' (McGraw-Hill, 1917), Eason and Wesen's 'English, Science, and Engineering' (Doubleday, Page & Co., 1918), and Baker's 'Engineering Education: Essays for English' (Wiley, 1919). The obvious advantages of this course are in its probable stimulation. It is the theory of Professor Aydelotte, originator of the plan that after a brisk classroom discussion of one of the essays, the members of the class will become filled with ideas and with enthusiasm for expressing them. With a sympathetic teacher, skilled in leading classroom discussions, this result may be reasonably expected; with a dull, indifferent, and indolent teacher, on the other hand, these classroom 'discussions' may easily degenerate into vapid and hypocritical comments by both teacher and students, and the prime object of all work in composition, instruction in writing, may be lost sight of.

The third type, usually given, I believe, after the first year, is frankly professional in aim. On the assumption that the great majority of engineers are likely to write more technical descriptions, explanations of processes, reports, and business letters than any other kind of composition, the students are trained in these forms. It should not be understood that the student themes are highly technical or complicated but that the student is doing the same kind of writing as is the practising engineer; his explanation of how he wired his house, and his description of the chemical laboratory differ only in degree of difficulty, not in kind, from the papers of his seniors. The advantages of this method of drill are in the interest which it arouses in the student, who is made to see at once the relation of English to engineering, and

in the direct application of his training in English to his practice. Shortly after I had introduced a course of this type in the junior and senior years of the engineering school of a large Middle-Western university, I was told by one of the engineering instructors that there was a noticeable improvement in the quality of the senior reports and theses. The disadvantages of the course arise from the difficulty of securing instructors with a sympathetic point of view and a willingness to do the work painstakingly and thoroughly, and from the danger of binding the student too narrowly to his technical interests. To avoid this latter danger I believe that the course in technical writing should follow, not supplant, the cultural course in English composition. The special texts which so far have been prepared for courses in technical writing are: Earle's 'Theory and Practice of Technical Writing' (Macmillan, 1911), Sypher's 'Handbook of English for Engineers' (Scott, Foresman & Co., 1913), and my own 'Composition of Technical Papers' (McGraw-Hill, 1917).

I have taught English composition to engineering students under all of these systems, but since editors of technical journals are interested chiefly in technical papers, I will outline some of the aims and methods which have guided me in giving courses of the third type. It should be understood that many of these are also applicable to the other types of instruction which I have enumerated.

First let me sketch the general objectives of a course in technical writing. English is regarded frankly as a tool, and students are taught to understand its value as a tool and to think of written expression as natural and not unusual even for engineers. An effort is made in the course to bring the prospective engineers to regard the technical journals as a great unfinished but ever growing encyclopaedia of engineering knowledge, in the making of which it is at once their duty and their privilege to assist and through which they may touch elbows with other workers in their great profession. Through their theme writing they are given fundamental training in logical thinking; they are taught to make careful conservative statements, to avoid wild generalities and *post hoc, propter hoc* fallacies, to test the validity of their evidence and its applicability to a given conclusion, to indicate the limits of possible error and alternative solutions which should fairly be considered—in brief, to draw tighter the meshes of their thinking. They are trained further to keep constantly in mind the point of view of their readers, to remember that ideas and facts which may be perfectly clear to writers who are engineers may not be equally clear to laymen. They are frequently instructed to write an explanation or a description as it should be presented to engineers, then to city councilmen, then to farmers, and they are graded on the skill which they show in selecting their facts and adapting them to the intelligence and special interests of their particular audience.

In teaching engineering students to write themes, I have never attempted to accomplish too much; it is much

better to aim at securing clear organization and correct expression than to try to develop literary style. "All engineering students," a professor of electrical engineering once said to me, "tend to think in terms of formulas." I believe that he is in general right, and I give my students compositional instructions that are definite and understandable even if not always easy to apply immediately. Some of these are: (1) Begin every paper with a clear statement of your subject. (2) Have a logical plan clearly in mind, and announce the new divisions of your paper as you come to them. (3) Proceed usually from general statements to details—not conversely. (4) Explain things which your reader does not know in terms of things which he does know. (5) Write fairly short paragraphs—not over two hundred words—each devoted to a definite phase of your subject that is stated clearly at the beginning of the paragraph. (6) Make sure that every sentence is as clear to your room-mate as it is to you.

The elements of the course are classroom talks on writing, and classroom criticisms, *pro* and *con*, of student themes and published articles on technical subjects, papers, which are corrected and criticized by the instructor and returned to the student for his correction, and frequent personal conferences in which the peculiar besetting compositional sins of the student are hammered persistently and relentlessly. All of this work is accompanied by a continual drum-fire drive against bad thinking and bad structure, and against illogical statement, rambling sentences, weak reference of pronouns, misplaced sentence parts, and all the thousand and one evils of bad craftsmanship that wear out the blue pencils of worried editors. At the end of such a course if the student does not have the style of Huxley, he can usually, at least, write more correctly and more clearly, and is better prepared to share creditably in the making of a technical journal.

By announcing at the beginning of this paper that I should conclude with some suggestions as to how editors of technical journals might help college teachers of English to train engineering students to write, I did not mean to imply that editors have not already done much in this direction. Concern with the finished product has certainly not kept some editors from doing what they could to help make better writers. I have in mind such activities as those of Mr. G. A. Wardlaw, whose address on 'Literary Engineering' appeared in the 'Sibley Journal' several years ago, of Mr. G. M. Wood, author of an excellent manual for the guidance of members of the U. S. Geological Survey, and of Mr. T. A. Rickard, whose accurate and scholarly 'Technical Writing' (Wiley, 1919) sets a high standard for all contributors to technical journals. By continued insistence upon clear and correct and carefully prepared manuscripts, and even, I believe, by occasional 'lessons' in composition in the pages of the journals—simple hints to authors similar, perhaps, to those published in pamphlet form by the A. I. E. E.—the editors can keep up among engineering contributors an interest in high standards of literary work. And by

pressure brought to bear upon the administrations of technical schools and colleges to give more work and better work in English, and by closer associations with teachers of English composition in these schools, editors may assist greatly in the training of students. Teachers of English composition in engineering schools will welcome such sympathy and assistance, for after all editors and teachers have the same aim—that of eliminating error and of gradually improving literary craftsmanship in the engineering profession.

Ore-Testing at Golden, Colorado

The current bulletin of the Colorado School of Mines explains three arrangements under which its metallurgical testing plant may be used by the public.

(A) Any responsible person or organization may, with the consent of the director, use the equipment by paying for the actual material, labor, power, water, expert assistance used, and depreciation. In this case the person using the plant is responsible for the accuracy of the results obtained.

(B) The director of the plant and his assistants will conduct a test, in which case a charge equal to the cost of similar work done by a commercial testing plant or by a consulting engineer will be made. If desired, the director will make an estimate of the cost previous to starting the work, but this will not be used in billing the actual charges. The director will be responsible for the accuracy of the results, and will make a report to the person authorizing the test without stating that the ore comes from any particular mine or locality, unless he supervises the arrangements for taking the samples. The director will not suggest suitable devices nor recommend machines put out by various manufacturers for the commercial plant that will subsequently be built as a result of his test-work. The person receiving the report of the test-work should employ a consulting engineer to advise further in regard to the building of a commercial treatment plant.

(C) A person or organization desiring to conduct a prolonged research may establish a fellowship at the school under the director, to cover a period of one year or longer, and the fellow may give all or part of his time to the special research work. In the latter case, the greater part of his time will be devoted to the special research and the remainder to post-graduate study. The person establishing the fellowship will pay the salary of the fellow and the actual cost of material, labor, power, water, and depreciation necessary for the research work. The director and his staff will supervise the work of the fellow without charge, will assume the responsibility for the accuracy of the results obtained, and will make a complete report of the work performed. This will not be published for a period of two years without the consent of the person establishing the fellowship. Any patents to cover any part or all of a process developed by the fellow under this agreement will be assigned to the person establishing the fellowship.

The Fairhaven Silver-Lead District, Alaska

By Lewis A. Levensaler

INTRODUCTION. The mining area to be described is on the north drainage of the Seward Peninsula, in latitude $65^{\circ} 40'$ North, longitude $162^{\circ} 30'$ West, at an elevation of approximately 500 ft. above sea-level.

The district is reached from Seattle by steamers of the Alaska Steamship Co., by way of Nome to Kiwaulik, on Kotzebue Sound, or by launches from Nome to Kiwaulik, 350 miles, thence to Candle by small river-boat, from which point wagons can be used or sleds in the winter, a distance of 28 miles to the camps.

Candle is a town of about 100 population at the junction of Candle creek and the Kiwaulik river. The town has a good general store, two hotels, a post-office, and tele-

Native coal as fuel can be used for a limited amount of power during development, but eventually other arrangements would have to be made. The native coal is an inferior grade of lignite. The veins dip at a steep angle and are badly crushed and broken. Neither the quality of the coal nor its physical condition offers much encouragement for development. There is one hydro-electric possibility in the district that can be utilized for six months in the year.

TOPOGRAPHY. Practically the entire northern half of Seward Peninsula is characterized by broad rounded hilltops and wide shallow valleys. Everywhere there is evidence of long and continued erosion suggesting great age. The surface is covered with tundra and coarse bunch-grass forming what is known as 'nigger-heads'. The area is practically treeless, although a very limited amount of scrub spruce grows on the tributaries of Independence creek. In the summer the district is well supplied with water and small streams, none of which are navigable.

GEOLOGY. The mineral zone that harbors these silver-lead deposits has been traced a distance of about a mile. The general strike is north and south with a fairly steep westerly dip. The exposed rocks are mostly schist, limestone, and granite. With the excep-



THE INDEPENDENCE MINE, AT THE JUNCTION OF INDEPENDENCE CREEK AND THE KUGRUCK RIVER, IN ALASKA

phone connection with Nome, which is served by both wireless and cable from Seattle.

Navigation in Bering Sea opens early in June and closes early in November. During these five months the Alaska Steamship Co. makes four trips to Nome and one trip to Kotzebue Sound. Therefore, all freight to and from the district is dependent on one steamer per annum.

Freight-rates from Seattle to Kiwaulik (ship's tackle) average \$15 per ton, lighterage \$7, on river boat \$3, plus \$60 per ton from Candle, or \$85 per ton to the camps. Winter freight can be contracted in quantity from Candle to the camps for \$20 per ton. The cost of feeding men averages \$3 per day per man. All labor is paid \$5 per day and found. The quantity is scarce and the quality poor. With reference to hard-rock miners, there is practically none of this class of labor in the country. Miners would have to be imported until a number of properties are operating. Except for boat-work and packing, Eskimo labor is worthless.

tion of an occasional granitic stock, there is an absence of igneous rocks. The older formations, largely made up of sedimentaries, have been so altered and sheared by severe dynamic metamorphism that it is impossible to identify the rock from which the present schist is derived.

The schist and limestone strata are highly inclined, and it is along their faulted contacts that the mineralization has taken place.

The ore is made up of argentiferous galena, zinc-blende, gray copper, and a small amount of pyrite.

The veins or contact shear-zones are filled with fault material containing bodies of siderite replacing limestone to a variable extent. Galena and zinc-blende, the principal ore-minerals, are later than the siderite and occur as a replacement of both the limestone and the siderite. This sequence has an important economic bearing on the deposits.

The well-crystallized character of the minerals sug-

gests that the deposits are later than the deformation of the region, that is, the mineralization took place after the limestone and calcareous schist were inclined to their present position. Cross-slips, existing prior to the mineralization, undoubtedly control the forming of the ore, as reflected in the assays of samples on the foot-wall side of the faults. Along these slips much movement and subsequent faulting has taken place.

The principal development in the district consists of a shaft 140 ft. deep from which two levels have been run. This shaft was sunk on an outcrop of good lead ore, a sample 18 ft. down the shaft returning 30.5% lead and 27.8 oz. silver per ton, across a width of five feet. A drift has been started at the 40-ft. level following the schist-limestone contact. The limestone on the hanging wall has suffered the greatest deformation, the schist on the foot-wall being more defined. This level has disclosed four separate faulted orebodies:

No. 1 averages 10 ft. wide by 75 ft. long with a value of 6.8% lead and 6.1 oz. silver per ton.

No. 2 is 38 ft. across at the widest point and possibly 20 ft. long, assaying 7% lead and 10 oz. silver per ton.

No. 3 averages 7 ft. wide for a length of 75 ft. with 6% lead and 6.4 oz. silver. A composite of the samples from this body returned 8.6% zinc. This percentage and ratio of zinc undoubtedly will be found to exist in all the ore in the mine.

No. 4 averages 10 ft. wide for 25 ft. in length and assays 6% lead and 5.3 oz. silver. The face of this orebody, which is the extreme south breast of the 40-ft. level, is stronger and better defined than other exposures in the mine; in fact, the workings seem to be getting into a less broken country to the south.

The irregular dimensions of the above described orebodies are due to faulting. On the 140-ft. level only one orebody has been defined; this will average 5 ft. wide for a length of 35 ft. and contains 3.4% lead and 2.5 oz. silver per ton. The south face is just entering a well-defined mass of siderite showing occasional bunches of good lead ore.

A picked sample of clean galena from boulders of 'drag' in the fault returned 61.6% lead and 40.4 oz. silver. A picked sample of clean galena, occurring largely as a replacement of limestone, returned 52.4% lead and 46.8 oz. silver. A picked sample of clean galena, occurring largely as a replacement of siderite, returned 61% lead and 54.1 oz. silver per ton. These samples were carefully selected for the purpose of determining the grade of galena and the ratio of silver to lead.

The importance of the district depends on favorable results from further development with depth or at some point along the vein; particularly if this development demonstrates that the replacement of siderite by galena is found to be more complete than at any point where it is now exposed.

The ground is soft and heavy and is held together by frost. Underground temperatures range from 28° to 30°F., to a depth of 140 ft. When connections are made for ventilation this frost will probably leave the ground

during the summer. In this event mining will necessitate the use of timber, of which there is a great scarcity in the district.

Lead Mining in Western Australia

There has been a revival of mining in the Ajana district in Western Australia according to the 'Chemical Engineering and Mining Review'.

Lead mining has been carried on in the vicinity for nearly half a century. In the early days several mines were worked by convict labor, and the ruins of the old cells and exercising yards, which were built of solid stone, can still be seen at Geraldine, the principal town. The lead was smelted at a central smelting works, about three miles south of Geraldine. The old stack is still standing on the top of a small hill, and can be seen miles away from all directions. The lead was then carted about forty miles to Port Gregory, and loaded as ballast on sailing vessels going to England.

The principal mine at work in this field is the Surprise. This mine was not worked in the early days, but has produced during the past twelve months 3000 tons of lead concentrate containing 70% lead. The lode is from 15 to 20 ft. wide, and in places 8 to 12 ft. of solid galena has been worked, it being only necessary to break the ore, raise it to the surface, and bag it. The Surprise mine has only been worked for 100 ft. vertically and for a distance of 180 ft. along the lode, but the whole of the machinery, working expenses, and development work have been paid for from profits. The clean ore is bagged, and the other lode material is sluiced; in this way an output of over 100 tons of lead concentrate per week has been maintained. The sluice tailing contains about 15% lead, and will be treated again. A mill has just been completed, consisting of a rock-breaker, three sets of rolls, four trommels, four jigs, and three Wilfley tables driven by two suction gas-engines with an aggregate capacity of 95 horse-power.

AUTOMOBILE statistics for 1920 given by Alfred Reeves, general manager for National Automobile Chamber of Commerce, follow: Automobiles registered in the United States, approximately, 8,500,000, of which 7,600,000 were passenger cars and 900,000 trucks; cars and trucks owned by farmers, 2,500,000; special taxes paid annually by the industry to the Government, \$257,000,000; registration fees, \$81,000,000; amount paid by the industry to railroads for freight shipments, \$100,000,000; cars and trucks produced, 2,241,000, of which 1,906,000 were passenger cars and 335,000 motor-trucks; wholesale value of cars and trucks produced, \$2,136,183,676; wholesale value of passenger cars, \$1,703,437,213 and of trucks, \$432,746,463; average wholesale price of passenger cars produced, \$897, and of trucks, \$1273; value of motor vehicles and parts exported, including engines and tires, \$338,000,000; number of passenger cars exported, 153,000; value of passenger cars exported, \$155,000,000; number of motor-trucks exported, 27,000; value of motor-trucks exported, \$45,000,000.

Canadian Mining in 1920

The year 1920 was a good one for the Canadian mining industry; the estimated value of the mineral production for the year is \$200,000,000 compared with \$176,686,000 in 1919 and \$211,301,897 in 1918, the comparative figures being as follows:

	1920	1919	1918
Total mineral production of Canada, value	\$200,000,000	\$176,686,390	\$211,301,897
Pig-iron, tons	1,080,000	917,791	1,195,551
Steel ingots and castings, tons	1,220,000	1,030,342	1,873,708
Copper, lb.	82,500,000	75,053,581	118,769,434
Zinc, lb.	42,000,000	32,194,707	35,083,175
Gold, value	16,000,000	15,850,423	14,463,689
Silver, oz.	13,500,000	16,020,657	21,383,979
Lead, lb.	35,500,000	43,827,699	51,398,002
Coal, tons	16,000,000	13,681,218	14,997,926
Nickel, lb.	61,500,000	44,544,883	92,507,293

One of the notable features of the year was the marked recovery in the production of copper, zinc, and nickel, and of coal. There was also a small increase in gold production. In respect of zinc, coal, and asbestos the highest production in the history of Canada was recorded.



BRITISH COLUMBIA

while the production of chromite, gypsum, fluorspar mica, and salt was well sustained.

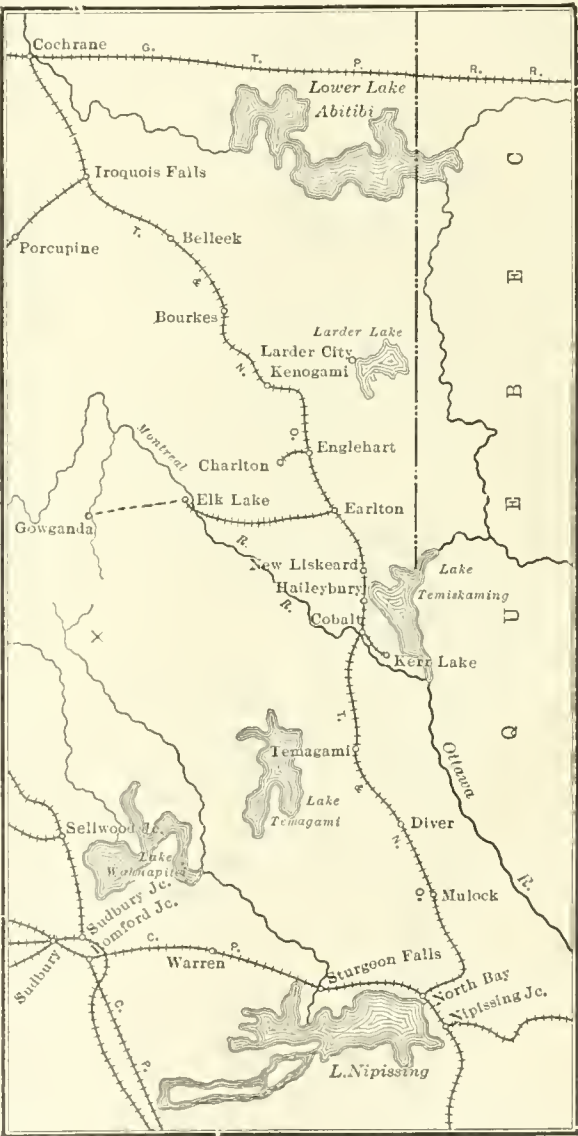
The decline in prices which made itself felt during the last three months of the year naturally had a depressing effect on production and some plants will probably remain wholly, or partly, closed until market conditions improve, or until a new level of cost makes operations more profitable.

Under the stimulus imparted by the War, Canada's mineral production increased from a total value of \$128,863,000 in 1914 to a value of \$211,300,000 in 1918. The reaction in 1919 resulted in a falling off to \$176,686,000,

practically the same value as was placed upon the 1916 production. As already stated the value of the 1920 production is put at \$200,000,000, a production exceeded only by that of the maximum year 1918.

During the past seven years value of the annual production has been:

	Metallic	Non-metallic	Total
1914	\$59,386,619	\$69,476,456	\$128,863,075
1915	75,814,841	61,294,330	137,109,171
1916	106,319,365	70,882,169	177,201,534
1917	106,455,147	83,191,674	189,646,821
1918	114,549,152	96,752,745	211,301,897
1919	73,262,793	103,423,507	176,686,390
1920	80,000,000	120,000,000	200,000,000



ONTARIO

The total production of nickel is estimated at 1,500,000 lb., an increase of 38% over the 1919 production and an output that has been exceeded only during the four war years, 1915 to 1918, inclusive. The annual production of this metal in Canada for some years to come will be limited only by the demands of the market. Canada has long

been the principal source of supply for the world's markets. The developed deposits assure an ore supply for many years, and smelting capacity has been provided considerably in excess of the highest production reached during the War. The completion by the British American Nickel Corporation of the smelter at Nickelton and the refinery at Deschênes, Quebec, the former having been placed in operation about January 18 and the latter in April, has contributed materially to the increased output during the year.

The production of copper is estimated at 82,500,000 lb., which, compared with a production of 75,000,000 lb. in 1919, shows an increase of 10%. The highest previous production was 118,769,000 lb. in 1918. The production from Quebec in 1920 was less than half that of 1919, the Eastis mine and mill having been idle throughout the year. In Ontario the production was increased about 25%. The shipments from Mandy mine in Manitoba were about the same as during the previous year. In British Columbia a slightly increased production seems to have been derived from the mines on the Coast.

The value of the gold production is estimated at \$16,000,000 as compared with \$15,850,423 in 1919. While the total value has increased during the past two years, the production is still less than that obtained in 1916, when the total was over \$19,000,000, or in 1900, when nearly \$28,000,000 was obtained.

Ontario probably contributed about 72% of the total gold production of Canada in 1920. This being derived from seven mines in the Porcupine district, three at Kirkland Lake, and several miscellaneous properties. The Yukon production, which has been steadily declining, shows a further decrease of about 30%. British Columbia's production is also believed to have declined about 20% though estimates for this Province at this time are based largely on conjecture.

Nova Scotia, Quebec, and Manitoba are at present but minor contributors to the country's gold production. Nova Scotia for many years boasted an annual production exceeding \$500,000, but in 1920 less than \$15,000 is reported to have been obtained. Some spectacular gold finds have been made in Manitoba, but the copper ore of the Mandy mine, up to the present, has been the principal source of gold. The development of the Flin-Flon may in a few years provide quite an important source of gold as a by-product.

The silver production for the year is put at 13,500,000 oz. or 2,500,000 below that of 1919. There appears to have been a general decrease from all sources. The Ontario production is estimated at about 10,500,000 oz., the falling off being due in part to shortage of power. The rapid decline in the price of silver beginning in January also tended to diminish output, particularly toward the end of the year. Silver from British Columbia has been mainly a by-product recovered from the treatment of lead, copper, and gold ores. The opening of high-grade silver ores, such as those found in the Dolly Varden mine at Alice Arm, gives promise of greater production. Those of the Mayo district, Yukon Territory, are also attracting

considerable attention, high grade ores having been found in this district.

The production of lead is estimated at 35,500,000 lb., or 8,827,000 less than in 1919. While British Columbia is the principal source of lead and zinc, these metals have also been obtained in important quantities in Ontario and Quebec. During 1920 there was a considerable falling off in the quantities of lead ores exported to the United States from British Columbia. Shipments from Quebec were about one-third those of the previous year, while Ontario's contribution has probably been increased by over 50%. The total production during the year is roughly estimated at 35,500,000 pounds.

The estimated production of refined zinc is placed at 42,000,000 lb. There was a distinct falling off in exports of zinc ore to smelters in the United States. The price was well maintained during the first nine months of the year, though with other metals it fell off at the end of the year.

The production of coal for the year is estimated to have been at least 16,000,000 tons, which is 2,500,000 tons or 18% over that for 1919. Alberta led the provinces with an estimated production of 6,700,000 tons, the estimated value of Canada's total production being \$70,000,000.

Iron-ore production fell away considerably during the year, it being estimated that shipments from the mines did not exceed 120,000 tons. These were mainly from the mines of the Algoma Steel Corporation at Magpie mine and Moose Mountain, Ltd., at Scilwood, Ontario. The shipments from both mines consist of a beneficiated product, roasted siderite, from the Magpie, and briquettes, from concentrated magnetites, at Moose Mountain.

The total production of pig-iron from blast-furnaces and electric furnaces in 1920 is estimated at 1,080,000 tons, and the total production of steel ingots and steel castings at 1,220,000 tons, both records showing a substantial increase over those of the previous year.

THREE MATERIALS for preserving timber for use in mines have been found suitable. These are coal-tar creosote, zinc chloride, and sodium fluoride. Creosote is the most effective in preventing decay. Timbers thoroughly impregnated with it are likely to resist decay until they are crushed or worn out. Occasional objection is made to the possible fire hazard of creosoted wood, but long experience indicates that the additional fire risk is small. Zinc chloride and sodium fluoride are odorless, and if anything they tend to reduce the inflammability of wood. They are cheaper than creosote and although they do not give such permanent protection they greatly increase the life of timbers. Coal-tar creosote may be applied by the brush, dipping, open-tank, or pressure methods. Zinc chloride and sodium fluoride may be injected by the steeping, open-tank, or pressure methods. The cost and effectiveness of the methods of treatment increase in the order given. The saving possible with any of them is so great that it will pay most mines to adopt the use of some preservative on permanently placed timbers.

Karl Eilers v. Guggenheims

Mr. Simon Guggenheim's letter to the stockholders, in reply to Mr. Eilers' allegations was as follows:

To the stockholders of the American Smelting and Refining Company and American Smelters Securities Company.

Many stockholders have requested more information concerning the suit recently brought against the Company by Mr. Karl Eilers than was obtainable from the press reports. It has accordingly been deemed desirable to print the proceedings and send a copy to every stockholder.

Attached you will find:

- (1) Mr. Eilers' petition;
- (2) Answering affidavits of Mr. Newhouse and Mr. Crockett.

The memorandum decision of the court is brief and I quote it in full:

“SUPREME COURT—SPECIAL TERM, PART I
By Mr. Justice Burr.

Eilers v. American Smelting & Refining Co. and ano.—The sole question involved here is whether the petitioner, a stockholder of the company, is unlawfully prevented from examining the stock book, contrary to the provisions of section 33 of the Corporation Law. In view of the sworn statement of the transfer agent of the company, that, acting under instructions from the company leave has been granted to petitioner to inspect and make extracts from the books of the company and that the representatives of petitioner have been and still are engaged in inspecting the stock books and making extracts therefrom, which fact was admitted and conceded by petitioner upon the argument, and it appearing from the papers submitted and the correspondence between the parties that the company has been at all times ready and willing to permit such inspection under reasonable conditions, the motion for a writ of mandamus is denied with costs. Submit order.”

Mr. Eilers in his petition, besides alleging a refusal by the company to permit an examination of its books, made various charges of misconduct or mismanagement on the part of the directors. These charges he could not be called upon to prove on the motion heard; they could be met only by denial and answer setting forth the facts; but they received wide publicity in the public press, to the necessary injury of the company. In view of the total absence of any legitimate ground for the action, stockholders are asked to judge for themselves whether the petition was filed in good faith. Counsel for the company (Mr. John B. Stanchfield, of Stanchfield & Levy) stated in open court:

“We challenge, upon the threshold, the good faith of this application. We say * * * * * that the whole proceeding is an imposition upon the Court; the petitioner has been neither fair nor candid in his treatment

of the Court, and the whole object that he seeks to attain is to use a judicial proceeding in a campaign for votes so as to escape the consequence of libelous accusations.”

I emphatically deny, both on my own behalf and that of my brothers, all charges of improper conduct made by Mr. Eilers in the following pages, and assert that at all times my brothers and myself have sought honestly and faithfully, to the best of our ability, to further the interests and the welfare of the American Smelting and Refining Company.

Our connection with the company's affairs began in 1901, and it is with pardonable pride that we point to the development of the company in the intervening period, as shown by the following comparison:

	1902	1919
Quick Assets	\$18,000,000	\$54,486,000
Profit & Loss Surplus. . .	2,900,000	25,974,000
Annual turnover	82,000,000	243,000,000

That the policy of the present management has been successful, is evident from the fact that in the fiscal year of the company ending April 30, 1901, the net earnings of the company were \$3,828,000, representing 3.83% of the then outstanding capital stock; during the six and two-thirds years ending December 31, 1911, the average annual net earnings were at the rate of \$12,145,000, or at the rate of 8.15% of the then outstanding capital stock; during the three years ending December 31, 1914, the average annual net earnings of the company were at the rate of \$12,165,000, or 8.28% of the then outstanding capital stock; during the three years ending December 31, 1917 (these being war years), the average annual net earnings of the company were \$21,375,218, or at the rate of 15.19% of the then outstanding capital stock; in the year ending December 31, 1918, the net earnings were \$13,887,000, being 11.10% of the then outstanding capital stock; during the year ending December 31, 1919, the net earnings were \$11,248,000, being 9.09% of the then outstanding capital stock, the latter year being a reconstruction year following the signing of the Armistice, during which industrial and commercial conditions were generally unsettled. (All figures for net earnings are without allowing charges for depreciation, as the company's records, prior to 1911, were kept on that basis.)

While my brothers, because of advancing years, have been compelled to restrict somewhat their business activities, so long as any of us are connected with the company, we shall continue, as in the past, to work faithfully and unselfishly for the company's best interests, and to exercise our best business judgment in the management of its affairs.

It is regrettable that a sensational and wholly unnecessary suit should have been brought in a period of drastic readjustment of all security values, inevitably causing a needlessly severe and unjustifiable fall in the market price of the stock of the company.

Respectfully,
SIMON GUGGENHEIM,
President.

Dec. 30, 1920.

Metal Production in Nevada in 1920

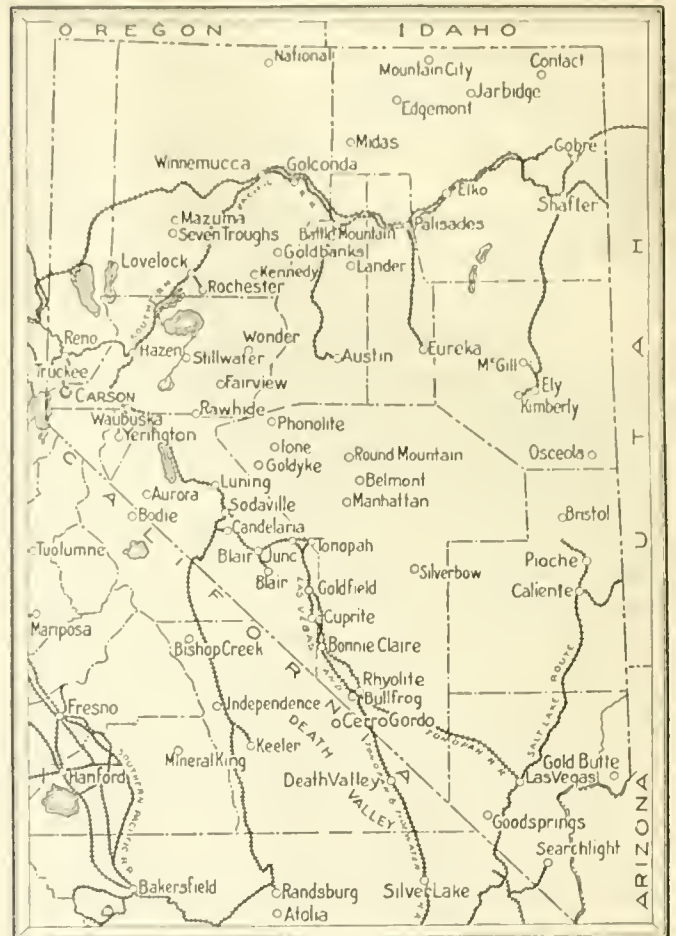
The gold output of Nevada decreased from \$1,541,502 in 1919 to about \$1,579,000 in 1920, a decrease of more than 21%. The Goldfield Consolidated property, for several years the largest gold producer in Nevada, was operated by the Goldfield Development Co. for a short time, and a comparatively small production was reported. The output of gold from the Tonopah district, however, increased from \$771,804 in 1919, to about \$1,063,000 in 1920, on account of the larger output of the accompanying silver, which was favored by a high price. The Nevada Consolidated company, at Ely, operating the largest copper mine of Nevada, was also the largest producer of gold in the State. The Elko mine, at Jarbidge, was the largest producer of gold from gold ores, and the Tonopah Belmont company produced the most gold from silver ores. Other companies that made an output of gold valued at more than \$150,000 each were the West End, Tonopah Extension, Consolidated Virginia, and Tonopah Mining. The Fairview Round Mountain, Round Mountain, Rochester Mines, Elko Prince, Montana-Tonopah, and Florence companies were also producers of gold, though several of these failed to reach the output of the previous year. The mines of the Comstock district were active, especially in development work, though their output of gold was somewhat less than in 1919, when they produced \$355,640. In the Rochester district, the Rochester Mines Co. was a large producer of gold, and there was a fair increase over the output of 1919. Late in the year the new dredge of the Gold Canyon Dredging Co. began operations near Dayton.

The mine production of silver increased in quantity from 6,863,580 oz. in 1919, to about 7,786,000 oz. in 1920, and in value from \$7,687,210 to about \$8,480,000. The large mines of the Tonopah district produced about 4,970,000 oz. of silver in 1920, against 3,568,875 oz. in 1919, and 5,299,920 oz. in 1918. The largest producers of silver were the Tonopah Belmont, West End, Tonopah Extension, Tonopah Mining, and Montana-Tonopah companies. Large quantities of silver were also produced by the Rochester Mines, Tonopah Divide, Spruce Monarch, Black Metals, Consolidated Virginia, Prince Consolidated, and Nevada Packard companies. The Comstock district produced about 268,000 oz. and several properties at Rochester produced about 572,000 oz. In Churchill county a decided decrease resulted from the idleness of the Nevada Wonder mine.

The output of copper increased in quantity from 52,331,175 lb. in 1919 to about 55,790,000 lb. in 1920, but decreased in value from \$9,733,599 to about \$9,551,000. The output was less than half of that of 1918. The Nevada Consolidated at Ely, in White Pine county, was the largest producer and contributed more than 4,000,000 lb. of copper per month; but the Consolidated Copper Mines in the same county made no effort to produce copper under the prevailing conditions. The Mason Valley smelter at Thompson, in Lyon county, was idle during the entire

year, and many of the mines of Lyon and Mineral counties therefore found it impossible to operate.

The mine output of lead increased in quantity from 15,349,370 lb. in 1919 to about 19,510,000 lb. in 1920, and in value from \$813,517 to about \$1,592,000. The Prince Consolidated mine at Pioche and the Yellow Pine mine in Clark county were large producers and there was a greater production from the Virginia-Louise, Black Metals, Bristol Silver, and Combined Metals near Pioche. Other large producers were the Spruce Monarch in Elko county and the Lonisium Consolidated in Nye county, where a new lead smelter was operated for a short time.



MAP OF NEVADA

Near Arden in Clark county a body of lead ore was opened in the Potosi mine, formerly a large producer of zinc.

The output of recoverable zinc increased slightly in quantity from 9,004,698 lb. in 1919, to about 9,100,000 lb. in 1920, and in value from \$657,343 to about \$737,000. In 1920, as in past years, most of the output was made in the Yellow Pine district in Clark county, where the Yellow Pine mine is the largest producer. The Consolidated Copper Mines in White Pine county made large shipments of zinc ore, but the output was only about half that of 1919. The average price of zinc for the year was more than eight cents per pound, but in November and December the price dropped and the Yellow Pine mine was closed.

REVIEW OF MINING

FROM OUR OWN CORRESPONDENTS IN THE FIELD

ARIZONA

FURTHER CURTAILMENT AT SACRAMENTO HILL.

BISBEE.—A further reduction of steam-shovel and stripping operations on Sacramento hill, to go into effect on February 1, has been announced by the Copper Queen branch of the Phelps Dodge Corporation. Operations on the hill were greatly reduced on the first of the year, and this reduction will leave but a small part of the normal force at work. The reduction, it is announced, is due to the present condition of the copper market and to delay in completing the 4000-ton concentrator that is being erected to handle the ore.

MIAMI.—Lateral development is being carried on by the Van Dyke Copper Co. on the 1550-ft. level to explore the zone of mineralization entered in the shaft at this depth. The present work is expected also to cut the orebody that was struck in the shaft between the 1183 and 1218-ft. levels, as the orebody dips in that direction. Preparations for sinking the shaft on the Louis d'Or property are progressing. The site for the shaft has been cleared and a good road built from the main Lost Gulch highway to the site. Work is held up temporarily pending the arrival of a new hoist and large horse-power boiler from Los Angeles. Five carloads of timber and other supplies have arrived at the site.

GLOBE.—The accident record of the Old Dominion Copper Co. for the past year shows a decided improvement, according to a report issued by W. G. McBride, general manager. The record is credited to the work of the men in the first-aid and safety classes. The following departments have made a perfect safety record for the year, having no lost time due to accidents in the entire year: electric shop, carpenter shop, and railroad. The following departments show a decided improvement over last year: mine department, underground; mine department, surface; crusher and sample-mill, miscellaneous surface. The mine department's underground record was marred by one fatal accident.

PRESCOTT.—Sinking operations with a force of about 30 men is about to be started at the property of the Kay Copper Co. at Canyon. The company has diamond-drilled the property and sunk a shaft 200 ft. New electric equipment has just been installed for further sinking operations.

KINGMAN.—It is announced by S. D. Stewart that the litigation involving the Schuylkill mine at Chloride has been settled. In the terms of the settlement the Garbutt

interests transfer to Richard H. Cole their holdings in the Schuylkill company as well as all claims against the property. Full payment to clear the property is to be made by instalments at regular intervals until February 1922 when the last payment is to be made. To bind the transaction \$40,000 has already been paid to Mr. Garbutt. A new corporation with a capitalization of \$10,000,000 is to be formed. Money to meet the payments and carry on active development at the mine is assured.

COLORADO

DREDGING OPERATIONS NEAR BRECKENRIDGE AND KOKOMO.

BRECKENRIDGE.—The Blue River Placer Mining Co. has been incorporated to take over and operate the dredge on the Lambing placer formerly controlled by the Blue River Dredging Co., whose interest is absorbed. The dredge is operating in the main stream of the Blue river where ample water is available for dredging.

CRIPPLE CREEK.—Properties resuming operations since the first of the year include the Blue Flag, Dante, Gold Sovereign, Pharmacist, and Findley, the last two are under long lease to the Le Brun company of New York. Heavy production is being made from the Cresson mine, the present week's shipments exceeding 1750 tons. Ore is moving forward to the Golden Cycle mill at the rate of eight to ten standard cars daily.

KOKOMO.—The Silver Queen mine in the Consolidated Ten Mile mining district of Summit county, owned by the Mutual Co-operative Mining Co., has been leased for a five-year term to the Kokomo-Recen Development & Dredging Co. and equipment is now being installed. The Terry process of flotation, tested successfully on Kokomo ores, is now being installed in the Wilfley mill. The district will benefit when the plant is ready to handle custom ore.

Machinery has been shipped to Kokomo by the National Mining & Development Co. for installation on the Golden Queen adjoining the Queen of the West, a former rich producer of high-grade silver ore. The company has tested its placer ground in McNulty gulch, the results indicating a maximum gold content of \$4.10 and a minimum of \$1.05 per yard. A dredge has been purchased and will be erected in the spring.

GEORGETOWN.—Development of virgin territory traversed by known lodes of Columbia mountain has been started by a cross-cut from the main tunnel of the Georgetown Tunnel & Transportation Co. The first of

these veins should be cut at 175 feet. The main adit is being extended into Democrat mountain. Local lease operators have secured blocks of the Waldorf-Imperial and preparations made for development. Denver men are reported to be financing operations. The working force at the Scepter property has been increased and production will be increased. A flotation unit is to be installed at the Burleigh mill at Silver Plume. The plant is being remodeled.

LAKE CITY.—Encouragement has been given operators by returns on a carload shipment from the Hiwassee mine. Settlement sheets show a lower treatment-charge made by the smelter, and payment is made for 3.2% lead. The ore shipped averaged \$100 per ton. This is the first time on record the smelter has paid for the lead content of Lake City ore. The Ute and Gladiator mines, old-time producers, are active under lease after long idleness and are again producing and shipping.

The Excelesior-Broker group of Capitol City is again producing under management of W. E. Mendenhall. The Capitol, Broker-Excelesior, and Yellow Medicine may be consolidated under the same management. A modern mill will be constructed if the merger is consummated.

TELLURIDE.—The Shoofly tunnel on the Carbonero group at Ophir is to be extended by the Ruttilla-Brown Leasing Co. While this work is in progress production will be maintained from the cross-vein now producing between 85 and 100 tons daily. During 1920 a large tonnage of milling ore was developed and several cars of high-grade ore netting \$2000 per ton were shipped by the leasing company. New machinery at the San Bernardo mill has been started with satisfactory results.

MICHIGAN

REVERBERATORY FURNACE AT QUINCY SMELTER COMPLETED.

CALUMET.—Calumet & Hecla has completed a shipment of 320,000 lb. of copper to France. This is the first good-sized order received in some weeks and it is considered an encouraging indication. Domestic business has become negligible and it is estimated that the shipments from all of the lake mines in January for Eastern points have not aggregated 200,000 lb. The Stanton mines—Mohawk and Wolverine—have not been selling metal for at least 30 days and none of the other Lake Superior mines is disposed to release its surplus until the market improves. Most of the copper piled up on the docks represents from 15 to 20c. per pound in cost and there is no incentive to dispose of the metal at current prices. Present production is costing less, but the average is not better than 14c. While the reduction in wages has had something to do with the decreased cost, the principal factor is the improvement in efficiency in all of the mines.

The new reverberatory-furnace plant at the Quincy smelting works at Ripley has been completed. It makes the Quincy smelter one of the most modern and complete in the district and will add greatly to its efficiency and capacity. The building, which is of steel, houses a

22 ft. Walker casting machine, arranged to turn out general shapes or anodes. The furnace is 16 by 32 ft., with a 300 hp. boiler in a by-pass stack of 100 ft. The furnace will refine 130,000 lb. at a charge, compared with the previous maximum of 55,000 lb. The plant is equipped with a 12½-ton 3 motor crane to charge the furnace and a 6-ton 4 motor crane to serve the casting-room, also a 2½-ton capacity slag-pot operated by a combination battery and trolley locomotive. The refined copper will be handled by an electric truck.

The New Baltic shaft of the Arendian Consolidated is now bottomed at 800 ft. Sinking will continue to a depth of 942 ft., which corresponds with the 900-ft. level of the New Arendian shaft, at which points the two shafts will be connected. The New Baltic shaft will reach its objective about March 1, it is expected. No drifting or stoping will be attempted until this preliminary work is accomplished. The New Baltic shaft is in the lode for the greater part of the time and the showing is declared to be encouraging.

NEVADA

REVIEW OF PRESENT OPERATIONS AT GOLDFIELD.

GOLDFIELD.—At 1440 ft. from the main south drift, the south-east cross-cut on the seventh level of the Florence is thought to be close to the vein, as the formation is harder and seams of quartz are showing. This cross-cut is timbered for the entire length with 10-in. round Oregon-pine timbers. Mellan and Howard, lessees working on the 152-ft. level of the Gem block, north-east of the Florence shaft, have shipped a carload of ore assaying \$155 to \$160 per ton, according to the final sampling at the mine. The ore-shoot has been exhausted above the level, but it has been followed for 20 ft. in a winze and other shipments will be made. The Smith lease on the Daisy block has shipped to Selby one-quarter ton of rich ore saved in following a narrow seam. Barker, Heiden, and Witt, leasing near the stope of the old Engineers' lease, have saved nearly a carload of good ore at a depth of 209 ft. Four headings are being driven in the Cracker Jack lease in the vicinity of the Little Florence shaft and two cross-cuts are being driven from the Red Hill shaft into the block leased by that company from the Florence. In all 14 headings are being driven by lessees. The first shipments from the Consolidated since the first of the year have been made from the Silver Pick lease on the Red Top and it is expected that a shipment will soon be made from the Poffenburger and Dunn lease on the Combination. The Silver Pick worked until January 1 under a five-year sub-lease from the Development and the lessees are now negotiating for a similar lease from the Consolidated. Meanwhile work is being done under a one-year lease, the ordinary term, and three carloads of \$35 to \$50 ore have been shipped, with enough in sight to make several more shipments. Compressed air for the lessees in the Combination and Mohawk is obtained from the Florence. Consolidated lessees work blocks of an average size of 300 by 300 ft. on a royalty basis of 10% of the net return on ore worth up to \$20, 15% on \$20 to

\$40 ore, and 20% on ore over \$40. Lessees are required to work a minimum of 30 shifts per month. Oxidized ore suitable for cyanidation is shipped to the Millers mill of the Tonopah Mining for a minimum of \$1.40 per ton, a special rate made by the Tonopah & Goldfield railroad, and the minimum treatment charge is \$5.25 per ton. The Grandma shaft is 935 ft. deep. It will be continued to 1000 or 1050 and if the east-dipping shale is not entered at about that depth a cross-cut will be driven west to it. The ore recently opened in a raise in the Great Bend is proving erratic in value, the assays varying from \$3.50 to \$75, but ore is being saved for shipment in the raise, which is 25 ft. into the ore-shoot.

RENO.—The precious metals experiment-station of the U. S. Bureau of Mines at the University of Nevada was dedicated recently with prominent Bureau and State officials present. S. C. Lind is in charge of the station. The seventh annual four-week prospectors' short course given by the University of Nevada will end on February 11. Twelve men are taking the course, four miners, a mine operator, two lawyers, a prospector, a real-estate man, a stockman, a machinist's assistant, and a railroad man. The subjects include mineralogy, geology, chemistry, mining law, surveying, and metallurgy.

UTAH

ALUNITE REFINING PLANT IS PROJECTED.

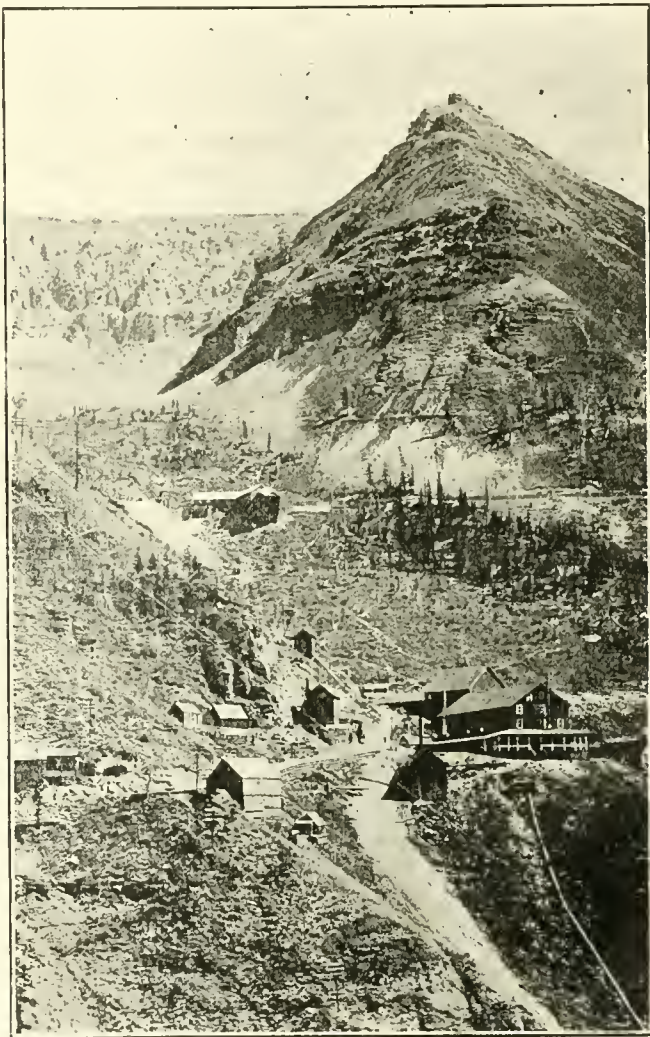
SALT LAKE CITY.—A joint meeting of the local sections of the American Institute of Mining and Metallurgical Engineers, the American Institute of Electrical Engineers, the American Society of Civil Engineers, the American Institute of Architects, and the American Society of Mechanical Engineers was held at the Commercial Club on the evening of January 27. Edwin S. Carman, who became president of the last-named organization on January 1, gave an address on 'Engineering Opportunities in America's World-Wide Activities'.

Articles of incorporation were filed with the Secretary of State on January 24 by the Utah Alunite Refining Co. The capital stock is \$500,000, divided into \$100 shares. The company's holdings consist of eight claims, situated about 16 miles from Richfield and about a mile from Vaca station on a branch of the Denver & Rio Grande railroad. All of the claims contain workable alunite deposits; there is so little overburden that much of the ore can be mined by steam-shovels. Four products are obtained, namely, potash alum, potassium sulphate, aluminum oxide, and aluminum sulphate. There is ample water for milling operations. R. H. Chirgwin, a chemical engineer of New Haven, Connecticut, is president, and Theodore Rodman of Salt Lake City is manager. Among the directors are S. H. Isaacs, a potash expert. It is the intention to erect a mill of large capacity during the coming summer.

PARK CITY.—The work of installing an electric pump on the 1700-ft. level of the Ontario mine has been completed, according to Newton Dunyon, superintendent. This pump, in conjunction with the others already in

operation, will be able to handle 2500 gal. per minute, should it be necessary to do so. The company will now undertake further development work on the 2000-ft. level, the deepest in the mine.

Only three of the local mines are now making regular shipments. In some of the neighboring canyons the snow is from three to seven feet deep, making it impossible to take supplies to the mines and to bring ore down from them. Another factor which is keeping the smaller mines and lessees from shipping is the higher smelting rates



SMUGGLER-UNION MINE, AT TELLURIDE, COLORADO

being asked by the Salt Lake Valley smelters, it being reported that 1921 contracts signed by local lessees provide for a deduction of 5c. per ounce of silver and 2c. per pound of lead, from market quotations, as compared with 3.5c. and 1.5c., respectively, heretofore. During the week ending January 22, the Judge Allied companies shipped 899 tons, Ontario 499, and the Silver King Coalition 541, making a total of 1930 tons.

EUREKA.—A Commercial Club has been organized by the business men of this district; one of the first subjects to be taken up by the organization is the matter of lower freight and smelting-rates on ore. Local mining men feel that there is something wrong when it costs \$1000

and over to ship and smelt a 50-ton car of ore. It is felt that the present freight rates to Salt Lake Valley smelters are too high, in spite of the fact that the railroads did not increase such rates last August, when the general advance of 25% was applied on all other commodities. It is further the opinion of local mining men that smelting rates should begin to decline, in view of the cut in wages made by the smelters on January 1, and the lower prices of material entering into smelting operations.

Ore shipments from this district for the week ending January 22 totaled 177 cars, of which the Tintic Standard shipped 72; Chief Consolidated, 28; Dragon, 17; Eagle & Blue Bell, 17; Iron King, 17; Victoria, 6; Iron Blossom, 4; Gold Chain, 2; Grand Central, 2; Mammoth, 2; Colorado, 2; Sunbeam, 2; Swansea, 2; Gemini, 2; Centennial-Eureka, 1; Eureka Mines, 1.

The resumption of work at the property of the Tintic Drain Tunnel is under way, according to Frank Birch, local manager for the Knight interests. The company intends to drive a raise through to the surface from a point near the present face of the tunnel. The distance to be driven is about 600 feet.

BRITISH COLUMBIA

COPPER SHIPPED BY BOAT FROM VANCOUVER TO NEW YORK.

VANCOUVER.—The steamship 'Stanley Dollar' is making a special trip by way of the Panama Canal to convey a large consignment of the Granby company's blister copper to New York. It is estimated that the trip will take 28 days. When the blister was sent by rail the average period in transit was 60 days. The Granby is now turning out about 2,750,000 lb. monthly. The Vancouver branch of the B. C. Prospectors' Protective Association has forwarded a resolution to the Provincial Minister of Mines protesting against favoritism in the construction of trails and urging that better protection be provided for prospectors' cabins, caches, and closed mines, and that blasting-powder be provided to prospectors at cost.

VICTORIA.—Retroactive legislation, it is claimed, has made the Nickel Plate mine, at Hedley, subject to the payment of \$70,000 in provincial taxes. G. P. Jones, manager for the Hedley Gold Mining Co., has been in conference with the Government and has suggested that the amount should be halved, on the understanding that the \$35,000 thus released, together with a like amount provided by the company, shall be used in the development of the mine, and in this way help the general unemployment condition throughout the Province.

TRAIL.—The effect of the Consolidated company's new arrangement of paying for custom ore in warehouse-receipts, instead of cash, is shown in the ore receipts for the first two weeks of the year, during which only 13,148 tons was received, of which all but 264 tons came from the company's own mines. The company appears to be curtailing production from its own mines. The following is the output of metals from the smelter during last year, the output for the month of December being estimated:

gold, 42,636 oz.; silver, 1,098,014 oz.; copper, 4,750,000 lb.; lead, 25,724,000 lb.; and zinc, 37,131,000 lb. It will be noticed that, while the preliminary estimates by the provincial Department of Mines credits the Sullivan mine with 70,000,000 lb. of zinc, the Consolidated company only claims a production of 37,131,000. A large proportion of the copper produced at the smelter last year came from the Mandy mine, at Le Pas, Manitoba, and therefore is not credited to this Province.

ONTARIO

REGULATIONS REGARDING OIL-EXPLOITATION ARE TO BE REVISED.

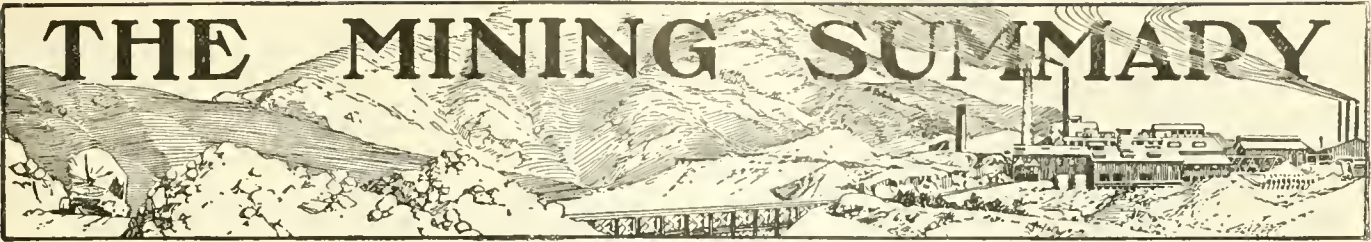
In view of the recent discoveries of oil at Fort Norman on the Mackenzie river the Canadian government has issued an Order-in-Council suspending the regulations regarding petroleum and natural gas in the North-West Territories. It is explained that this is merely a temporary measure, adopted to give the Government an opportunity to consider the whole situation. The permanent policy of the Government regarding oil and gas development in the North-West will be announced in the course of a few weeks before the anticipated rush into the oil country begins. It is understood that those who have already filed on claims will be protected. The order went into operation from January 19.

PORCUPINE.—At a meeting of the shareholders of the Davidson Consolidated, on January 18 it was decided to sell the mine to an English syndicate which has already purchased 1,000,000 shares of treasury stock at 75c. per share and will buy in the outstanding stock in the hands of shareholders at \$1.18 per share. It is intended to reopen the mine on March 1 and proceed with the erection of a 500-ton mill. R. C. Fielding, consulting engineer, who made an examination of the property on behalf of the purchasers, reported that apart from the veins already opened there are great probabilities that further orebodies of profitable grade await discovery. He states that the vein at the 550-ft. level, 19 ft. wide, looked strong and it was safe to assume that the ore would continue to a greater depth. Including 'probable' ore, he estimated the tonnage disclosed by the work done at 350,000 tons, averaging \$11 per ton of recoverable metal.

An important orebody has been found at the Dome Mines in cross-cutting at the 1050-ft. level. The width of the vein has not yet been determined but the ore is stated to be richer than that on the upper levels, averaging \$20 per ton.

COBALT.—The leading producing companies are storing their silver bullion in the hope of a rising market. It is officially stated that the Nipissing has nearly \$1,500,000 worth of silver in storage and the Mining Corporation of Canada has also a large quantity on hand.

Good quantities of milling ore in the veins recently discovered on the Bailey and University properties have considerably increased the importance of these finds, which are about 900 ft. apart and both in virgin territory. The Bailey vein has been developed for 60 ft. and carries 5000-oz. ore in some places.



THE NEW YORK MEETING OF THE INSTITUTE

The one hundred and twenty-third meeting of the American Institute of Mining and Metallurgical Engineers is to be held in New York City from Monday, February 14, to Thursday, February 17, inclusive. The annual banquet will be held at the Waldorf-Astoria hotel on the evening of February 16, following a reception to the outgoing president, Herbert C. Hoover, and his successor, Edwin Ludlow, and their wives. There will be the usual technical, social, and entertainment activities.

SAN FRANCISCO SECTION MEETS ON FEBRUARY 8

At the regular monthly meeting of the San Francisco section of the Institute, to be held on February 8, C. M. Eye, who lately returned from the Benguet Consolidated mine in the Philippine Islands, will address the members on 'The Development of the Mineral Resources of the Philippines'. A number of other members who are familiar with conditions in the Islands will join in the discussion. The meeting will be preceded by the regular dinner at the Engineers Club, commencing at 6:15.

SALE OF THE ALICE MINE TO THE ANACONDA COMPANY IN 1911 IS ANNULLED

Minority stockholders of the Alice Gold & Silver Mining Co. won their suit in the Supreme Court to have annulled the sale of that company's properties at Butte to the Anaconda Copper Mining Co. The contention of the minority that the sale was void because the interests controlling the Anaconda company had a monopoly of the copper trade was denied by the Supreme Court. There was nothing to show, the court said, that the Anaconda exercised such control over the market at the time of the sale in 1911.

The minority stockholders claimed that the holders of the majority interest were not authorized to dispose of the holdings against protest of any of the stockholders. The sale was accomplished by the transfer by the Anaconda company of \$1,500,000 of its own stock for the Alice properties, which the lower court held was not justifiable.

The court based its decision on the findings in lower courts that the price was inadequate, and said the fact that no bid was received at a public offering was not evidence that a sale could not have been made at a higher price.

Referring to the contention of the minority that the sale should be annulled because it was negotiated between two directorates having a common membership, the opinion said:

"John D. Ryan, at the time of the sale, was president and a director of the Alice company; he was also a director and general manager of the Anaconda company. In 1905 he obtained an option on the majority of the Alice company stock for \$600,000 and carried it until purchased by the Butte Coalition company, an Amalgamated subsidiary, of which he was a director, and that company voted a majority of the Alice stock in favor of the disputed sale.

"The record shows beyond controversy that Ryan was the representative of the chief investors in the enterprise; that he dominated the conduct of the practical administrative affairs of the Amalgamated and Anaconda companies, and that he very certainly was in control of the boards of directors of the companies which were parties to the sale of the Alice properties.

"The relation of a director to his corporation is of such a fiduciary nature that transactions between boards having common members are regarded as jealously by the law as are personal deals between a director and his corporation, and where the fairness of such transactions are challenged the burden is upon those who are maintaining them to show their entire fairness, and, where a sale is involved, the full adequacy of the consideration."

The opinion then pointed out that the lower courts had in each case agreed that the price offered for the Alice properties was "inadequate", when their value was considered, and had ordered a public sale before confirming the private transactions.

"Sale under a hammer has come to be synonymous with a sale at a sacrifice," the court remarked in refusing to approve this method of establishing adequacy of consideration offered for the property.

GOLD AND SILVER PRODUCTION OF ONTARIO

The production of silver and gold from the district of Temiskaming since the discovery of silver in Cobalt in 1903, and the finding of gold in the Porcupine field in 1909, has reached a grand total of over a quarter of a billion dollars.

It may be summarized as follows:

Silver	\$191,704,275
Gold	59,760,270
Total	\$251,464,545

Added to this are several million dollars in by-products, making a total of perhaps close to \$260,000,000.

Dividends paid during 1920 compare as follows with 1919:

	1920	1919
Silver mines..	\$4,058,142.50	\$4,232,241.00
Gold mines ...	3,240,042.42	2,368,039.50
Total	\$7,298,184.92	\$6,600,380.50

Dividends paid by the silver and gold mines of Northern Ontario since 1904 up to the end of 1920 are as follows:

Silver mines	\$82,575,040.72
Gold mines	18,785,280.20
Total	\$101,360,320.92

In addition to this amount of net profit distributed among the shareholders of the mining companies, about \$4,000,000 may reasonably be estimated to have been earned by close corporations, thereby bringing the total up to \$101,360,320.92.

ALASKA

Hyder.—The cold weather has put the road to the Premier mine in excellent condition. A Holt tractor, drawing four sleighs, is hauling the heavy machinery as far as Nine Mile. Ore is hauled on the return trip. The survey for the aerial tramway has been completed and the work of installation will proceed at once.

ARIZONA

Duncan.—Excavation work for the stamp-mill of the Ash Peak mine is almost completed. Most of the mill machinery is on the ground. It is reported that there is sufficient gold

and silver ore on the dumps to keep the mill in operation for several years.

Humboldt.—Messrs. Lane and Malby of Alamogorda, New Mexico, are arranging details for the removal of a small gold mill from Casas Grandes, Mexico, to their property which is situated near the United Arizona mine 30 miles south of Mayer. A mill is also being erected at the Gloria mine at Canyon adjoining the Gillespie property.

Jerome.—J. J. Sweeney, Judge of the Superior Court, has issued an interlocutory injunction in favor of G. A. Kobold, L. J. Selby, and others restraining M. P. Frasier, G. D. Kase, G. Mitchell, and others from attempting to act as officers and directors of the Jerome-Superior Copper Co. or interfering with Messrs. Kobold, Selby, and others in their management of the company. The directors and officers enjoined have been charged with mismanagement and with attempting to elect themselves officers of the company at an alleged 'rump' meeting of certain stockholders in December 1920 at Jerome.

CALIFORNIA

Amador County.—The mill of the Central Eureka Co. is crushing ore of excellent grade obtained from the 3900-ft., or lowest, level of the mine. Operations have been resumed, after an idleness of almost a year, at the Bunker Hill mill. The opening of several high-grade stopes has increased the average mill-heads somewhat.

Eldorado County.—Discovery of rich gold ore is reported from the Gilt mine at Spanish Dry Diggings. The south drift from the bottom of the shaft is disclosing good ore, and in the King drift some high-grade has been found. The American Bar Mining Co. has been incorporated for \$500,000 by San Francisco capitalists.

Humboldt County.—The Electric Metals Co. of San Francisco is said to be planning the construction of an electric smelting plant on Trinidad Bay and is expected to obtain ore from Shasta, Siskiyou, and Trinity counties in California as well as from near-by States.

Lassen County.—The Hayden Hill mill is ready to commence operations. A rich ore-shoot was opened some months ago.

Porterville.—The large deposit of shale situated five miles east of here is to be developed by a company recently organized and known as the California Shale Brick & Tile Co. The company is capitalized at \$400,000. H. W. Lobb, of San Francisco, owner of the property whereon the deposit is situated, heads the corporation. There is said to be 120,000,000 cu. ft. of the ore in sight. This is the largest accessible deposit of shale in California. The company is negotiating for machinery for the plant. Building brick, of the pressed, faced, or common type, also hollow building-tile and irrigation and sewer-pipe will be manufactured. When hard-burned, sample bricks are thoroughly vitrified and impervious to water. Analysis of the shale shows it to contain silica, 68%; alumina, 16%; iron oxide, 4%; magnesite, 2%; lime, 0.58%; alkalis, 1.75%.

Sierra County.—The Mugwump mine, formerly known as the Young America, is being operated by Dennis E. Coughlan, who reports uncovering a deposit of rich gravel.

Trinity County.—A number of good finds have been made on the south fork of the Trinity river. Peter Foley and Charles Cross are reported to have opened a wide vein of good ore in their mine in Carrier gulch. Platinum is reported in the ore being mined by King Brothers on Hasayamp creek. The district is handicapped by a lack of cheap transportation.

Tuolumne County.—O. F. Heizer, manager of the Grizzly mine, has sunk the main shaft 150 ft. and drifted on a good vein on the lowest level of the mine. Figures recently announced by the Carson Hill Gold Mining Co. show that

during the last two years the mine has produced \$2,100,000 in gold from its Morgan mine. This is one of the few properties where operations have been profitable during the period of high cost. As much as 11,000 tons of ore has been crushed in one month in the 20-stamp mill; 10 stamps are being added to increase the capacity.

COLORADO

Cripple Creek.—A new 250-hp. electric hoist has been installed at the No. 2 Last Dollar shaft of the Modoc Consolidated Mines Co. The hoist was designed and built by the Wellman-Seaver-Morgan Co. and is said to be the most powerful electric hoist in Colorado. It is capable of raising a 3-ton skip from a depth of 2200 ft. with a rope-speed of 1200 ft. per minute. The company expects to have 100 miners in its employ by the end of the month. A carload of gold ore recently shipped by M. J. Rankin, lessee to the Jerry Johnson mine on Ironclad hill, was settled for at the rate of \$120 per ton.

IDAHO

Bonniers Ferry.—Development of the property of the Idaho-Montana Amalgamated Mining Co. is to be started. A long adit will follow the vein which was explored several years ago by means of cross-cuts and drifts from a deep shaft sunk from a point near the outcrop. Lead-silver ore has been found in the workings.

Coeur d'Alene.—Frederick Burbidge, general manager for the Federal Mining & Smelting Co., declared recently that the orebody on the 2000-ft. level in the Morning mine is the most important body of ore uncovered for years. Work of sinking the shaft from the 1800 to the 2000-ft. level was started four years ago and a station was cut on the 2000-ft. level. Drifting both east and west from the shaft developed an ore-shoot 800 ft. long, with a width of 27 ft. In some places the shoot is 35 ft. wide. In most of the older Coeur d'Alene mines the lead ore became base with depth but the Morning appears to be an exception. The ore on the 200-ft. level contains less zinc than any ore that has been taken out from below the 800-ft. level. The new orebody is 1200 ft. below the main tunnel-level of the mine. There are five levels, at 1800, 1600, 1400, 1200, and 1000 ft., between the recent discovery and the collar of the shaft.

The old Monarch property at Murray will be operated by lessees. A lease has been taken on all the levels between the 700 and 1100-ft. levels, including all of the mine equipment.

—The Brady Development Co., operating the Rose claims and the Olympia group under lease and bond, will soon resume work in extending the long cross-cut tunnel from the Headlight into the Brady claims. These claims, situated between the Tamarack and Greenhill groups, two of the richest properties in the Coeur d'Alene, were taken over a year ago under a lease and bonded by a syndicate headed by Patrick Brady. A shaft 100 ft. deep revealed ore similar to the Tamarack. Tunnel-rights were obtained on the old Headlight tunnel and a cross-cut was started to tap the ore in the Rose claim.

According to reports the Bunker Hill & Sullivan company is employing 1200 men in the mines, mills, and smelters; the Morning mine has 500 men; the Hercules company employs 500 men in its mine at Burke and its mill at Wallace; the Hecla company, with a mine at Burke and mills at Gem and Wallace, is employing 400 men; the Tamarack at its mine at Nine Mile district and the mill at Frisco in the Burke canyon, employs 200 men. It is estimated that 500 additional men are employed in the smaller mines. No protest came from the men when the recent wage cut of \$1 per shift was announced. The men at the mines in the Coeur d'Alene are now being paid wages averaging \$4.50 to \$4.75 per day.

Kingston.—At the Hypotheek mine, near here, a small crew of men is driving a new cross-cut adit in the direction

of a second lode. The work has advanced 300 ft. and within a short time the vein should be cut. Stringers cut recently show more mineralization than before and indicate the proximity of a vein.

MONTANA

Butte.—A bill has passed the Montana legislature favoring a resolution requesting Congress to impose a tariff of not less than one cent per pound upon imported manganese ore.—No. 3 shaft at the Butte & Superior mine has now reached a depth of 2530 ft. The shaft is in the Rainbow lode at this point, the ore running from 10 to 40% zinc. To date, no indications of any considerable change in the metal content of the ore from zinc to copper have been noted.

Cooke City.—G. L. Tanzier, general manager for the Western Smelting & Power Co., says that the smelting plant near here is 90% complete. The copper blast-furnaces at the plant will have a capacity of 300 tons per day. The

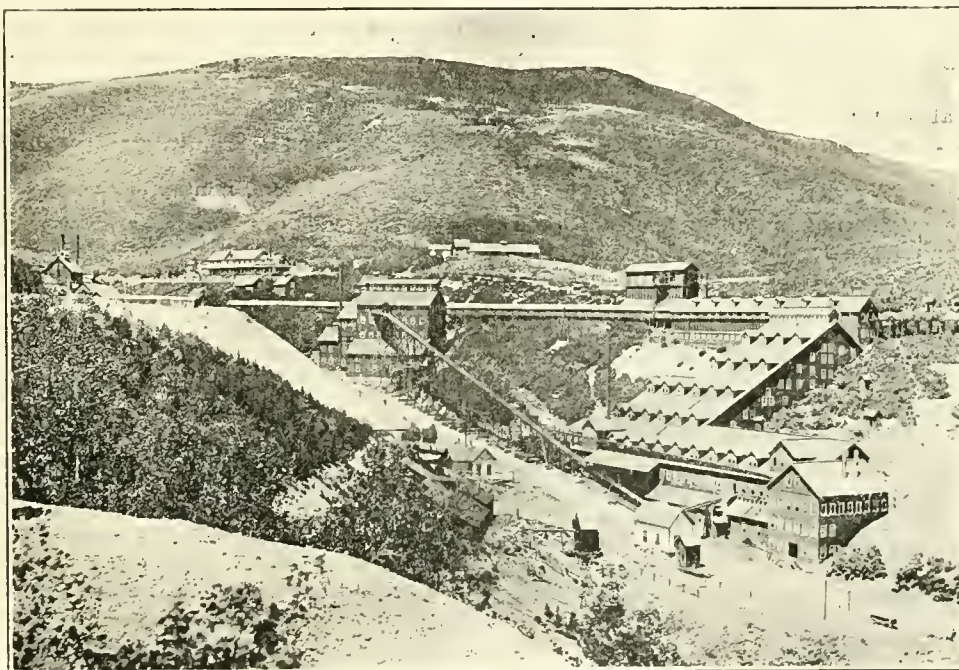
Divide.—It is reported that George Wingfield will resign as a director of the Tonopah Divide at the annual meeting to be held on March 2 and that Clyde A. Heller, president of the Tonopah Belmont, will be elected a director.

Goldfield.—Two carloads of \$35 ore were shipped from the Silver Pick lease on the Red Top mine of the Consolidated company, and Matt Murphy, superintendent, expects to continue shipments at the rate of two cars per week.

Klondyke.—A 7-ft. width of \$60 silver-gold ore is being entered by the Knox Divide. A winze has been sunk in ore 15 ft. from the 60-ft. level.

Pioche.—Shipments of silver-bearing fluxing ore from the Black Metals mine to the Salt Lake Valley smelters are being increased. New equipment has been installed and the mine is in better condition than ever before. It is expected to reduce the cost of mining, which has been \$4.15 per ton, to \$3 per ton, according to Jack Gilmer, manager of the mine.

Tonopah.—The first bullion shipments for the new year



SILVER KING MILL AT PARK CITY, DESTROYED BY FIRE ON JANUARY 27

company already has a hydro-electric plant on the Clarksford river four miles from here. A working-tunnel has been driven to cross-cut the orebodies in the mine on Henderson mountain two miles from the smelter.

Helena.—A second shaft, 2000 ft. west of the present one, will be sunk at the Willard mine in the Warm Springs district.

Libby.—The first shipment of ore from the Lukens-Hazel mine has gone to the East Helena smelter. A 200-ton concentrator is in operation at the property, where 100 men are employed.

Neihart.—Thomas Westgard, in charge of the Silver Dyke property on Copper creek, will drive a tunnel to explore the vein opened in the Marion shaft at a lower level. Indications in the shaft promise the opening of a large deposit of low-grade ore.

Lessees are mining good ore in the Moulton mine, but a sufficient quantity to warrant starting the mill has not been obtained.

NEVADA

Carson City.—Dixon Bros., lessees of the Southwest Comstock property, have opened high-grade ore. Ore obtained from development work is being shipped.

from the Tonopah mills were as follows: Tonopah Belmont, 83,000 oz. valued at \$91,300; Tonopah Extension, 50,910 oz. valued at \$56,000; West End Consolidated, 48,600 oz. valued at \$53,460. At the Tonopah Extension progress is being made in sinking the McKane shaft, which has now reached a depth of 1470 ft. At the 1540-ft. point connection will be made with the Victor shaft, thereby providing better facilities for developing the western section of the mine. The company has not yet completed the station on the north side of the Victor shaft at the 1880-ft. level, but cross-cutting has been started toward the Merger, Victory, and Murray veins.—A. E. Lowe, mine manager for the North Star Co., has shipped a 50-ton carload of ore to the McNamara mill that returned \$28.06 per ton. Progress is being made in driving the cross-cut on the 700-ft. level toward the Belmont workings. Arrangements have been made to connect the two mines.

West Divide.—A 2-ft. width of \$200 to \$300 ore has been opened in a drift driven south from a new cross-cut on the tunnel-level of the West Divide. This is the first ore found on the tunnel-level.

NEW MEXICO

Socorro County.—Tin has been found about 30 miles

west of Fairview and Chloride, and 80 miles east of Mogollon on Taylor and Diamond creeks near the Sierra county line. The formation is rhyolite reefs or dikes, 500 to 800 ft. wide, all impregnated with tin with traces of platinum in some places. Stream tin is found in the creek beds. The country has no good wagon roads, but there is plenty of wood and water. The New Mexico Tin & Metals Co., whose main office is at 67 Liberty street, New York, J. R. Murphy, president, has a tunnel in 360 ft. in ore.

OREGON

Rogue River.—The Ancient River Goldmining Co. is operating in the old channel of the Rogue river, about half a mile south of the town of Rogue River. The company has put in a 6-in. Byron Jackson centrifugal and a 6-in. S-type Allis-Chalmers pump, direct connected to a 75-hp. motor and delivering direct into a No. 1 giant. The bank of the river was worked for miles 30 years ago with good results. The bottom of the present river is conglomerate which runs up at a low angle under the bank, then lays flat for a few feet, when it dips steeply into the old channel. Great wealth is reputed to lie in this old channel, but the present workings are not sufficiently advanced to estimate values beyond showing that gold and platinum are present, and the gravel ranges to over 20 ft. in thickness, with a loose sand overburden, averaging about 6 ft. The usual difficulty of separating the fine gold from black sand is present. J. S. Taylor is manager.

UTAH

Park City.—Fire originating in the boiler-room at the Silver King Coalition mill on January 27 destroyed the concentrator, transformer-house, ore-bins, and part of the snowshed leading to the main shaft. The mill has a daily capacity of 300 tons. It was constructed in 1899 and has been in almost constant use since that time. It has been remodeled several times and recent tests with oil-flotation have given good results. The loss is completely covered by insurance, and the company proposes to replace the plant with a more modern mill. The loss is estimated at \$100,000, but a large part of the machinery can probably be salvaged. High-grade ore will be mined and shipped as usual, so that the income will not be materially reduced nor will a great many men be thrown out of work. Forrest Mathez is superintendent at the property and John Tallon is superintendent of the mill.

MEXICO

Monterrey.—Mining operations in the States of Coahuila and Zacatecas are more active notwithstanding the depression of the metal markets. Several of the larger and well established companies are making preparations for increasing their production; notable among these is La Esperanza company, which has its general offices in Saltillo. This company has recently increased its capital stock 50,000 shares, the new capital being used to expand production and make improvements. In the Santa Rosa mountains near Monclova, Coahuila, Santiago Cardenas is opening up a new group of mines containing silver, lead, and zinc ores. The San Marcos Mining Co. is preparing to begin extensive development work upon its mine in Coahuila, as is also the Perlita Mining Co. The Jimulco Mining Co. which has for many years yielded rich returns for its American owners, who live in San Antonio, is also enlarging the scope of its development work. Jesus Aguilar recently filed on five claims near the mine of the Jimulco company in the Jimulco district.

Many Americans are coming into Mexico for the purpose of investigating mines with a view to making investments in desirable properties. They are finding travel perfectly safe and they are going into the more remote camps under the same security against personal harm that obtained during the peaceful days of the administration of the late President Porfirio Diaz, it is stated.

PERSONAL

The Editor invites members of the profession to send particulars of their work and appointments. The information is interesting to our readers.

Morton Webber is at Salt Lake City.

O. B. Perry has returned to New York.

E. T. McCarthy writes from Shui Chow, in China.

George D. Nickel, of Denver, was in San Francisco last week.

Milnor Roberts has been visiting the mines of the Mother Lode in California.

Gomer P. Jones, general manager for the Hedley Gold Mining Co., B. C., is at Los Angeles.

Robert Clarke, of Denver, was in San Francisco on his way to Grant's Pass, Oregon.

James Frame, of Boston, is examining some silver properties near Chalchihuites, in Zacatecas, Mexico.

A. E. Wells, of New York, formerly of the U. S. Bureau of Mines, was here last week on his way to Anaconda.

Walter Harper, of the Anaconda Copper Mining Co., has been visiting the Eureka mine at Sutter Creek, California.

George C. Riser, superintendent of the Nevada Consolidated Copper Co.'s concentrator at McGill, was at Salt Lake City recently.

Harold A. Linke, mining engineer of Salt Lake City, has accepted a position with the Compania de Real del Monte y Pachuca at Pachuca, Mexico.

W. Lorrain Cook is now assistant superintendent for the Utah Salduro Co. at Salduro, Utah, where the company is engaged in the production of potash.

R. H. Channing, president of the Utah Consolidated Mining Co., is at Salt Lake City inspecting the company's mines and new concentrating plant in Pine Canyon.

C. H. Munro sailed on the 'Creole State' from San Francisco for the Federated Malay States on February 3. He will be resident manager for the Yukon Gold Company.

Arthur J. Hoskin, recently appointed geologist and engineer for the Colorado United Mines Co., has been spending most of the winter at the mines near Wall Street, Colorado.

Blanford C. Burgess has resigned his position as chief engineer for the Iron Cap Copper Co., Globe, to become managing director of the Adjust Mining Co., at Winkelman, Arizona.

OBITUARY

Benjamin Bowden Lawrence died of pneumonia on January 21 at his home, in New York, where he was born 63 years ago. After graduating from the Columbia School of Mines, in 1879, he went to Colorado, and, in due course, became manager of several notable mines. Afterward, for eight years, he maintained an office as consulting engineer at Denver. In 1901 he went to New York, where he remained in consulting practice for the rest of his life. As a boy he was assisted by a bursary while at Columbia University, and he took pains in later years to give similar help to young fellows not able to pay their way. He was an enthusiastic supporter of his alma mater and took a special interest in the School of Mines. The value of his advice was duly recognized by his being elected first a representative of the alumni on the board of trustees and then a life member of the board, always working in close co-operation with his friend, President Butler. Ben. Lawrence had a wide circle of friends among those engaged in mining and to them his cheery presence was always most welcome; he was of a co-operative, helpful, genial temperament, and assisted willingly in any effort to further the best interests of the profession. Many of us in the West mourn his loss deeply and will cherish the memory of his friendship always.—T. A. R.



METAL PRICES	
San Francisco, February 1	
Aluminum-dust, cents per pound.....	65
Antimony, cents per pound.....	9.50
Copper, electrolytic, cents per pound.....	13.75—14.00
Lead, pig, cents per pound.....	5—6
Platinum, pure, per ounce.....	\$65
Platinum, 10% iridium, per ounce.....	\$95
Quicksilver, per flask of 75 lb.....	\$50
Spelter, cents per pound.....	8.25
Zinc-dust, cents per pound.....	12.50—15.00

EASTERN METAL MARKET	
(By wire from New York)	
January 31.—Copper is inactive but steady. Lead is quiet and easy.	
Zinc is stagnant and lower.	

SILVER

Below are given official or ticker quotations for silver in the open market as distinguished from the fixed price obtainable for metal produced, smelted, and refined exclusively within the United States. Under the terms of the Pittman Act such silver will be purchased by the United States Mint at \$1 per ounce, subject to certain small charges which vary slightly but amount to approximately three-eighths of one cent. The equivalent of dollar silver (1000 fine) in British currency is 46.65 pence per ounce (925 fine), calculated at the normal rate of exchange.

New York		London		Average week ending	
Date	cents		pence		Cents Pence
Jan. 25.....	66.75		39.75	Dec. 20.....	63.77 41.18
" 26.....	66.87		40.00	" 27.....	63.77 41.03
" 27.....	66.37		39.62	Jan. 3.....	65.40 41.87
" 28.....	64.50		37.75	" 10.....	66.60 41.56
" 29.....	62.75		36.75	" 17.....	66.14 40.00
" 30 Sunday				" 24.....	66.56 39.94
" 31.....	59.87		35.12	" 31.....	64.52 38.16
Monthly averages					
Jan.	1919 101.12	1920 132.77	1921 65.95	July	1919 106.36 92.04
Feb.	101.12	131.27	...	Aug.	111.35 96.23
Mch.	101.12	125.70	...	Sept.	113.92 93.66
Apr.	101.12	119.56	...	Oct.	119.10 83.48
May	107.23	102.69	...	Nov.	127.57 77.73
June	110.50	90.84	...	Dec.	131.92 64.78

COPPER									
Prices of electrolytic, in cents per pound.									
Date		Average week ending							
Jan.	25.....	12.75	Dec.	20.....	13.71				
"	26.....	12.75	"	27.....	13.15				
"	27.....	12.75	Jan.	3.....	13.15				
"	28.....	12.75	"	10.....	12.87				
"	29.....	12.75	"	17.....	13.08				
"	30 Sunday		"	24.....	13.00				
"	31.....	12.75	"	31.....	12.75				
Monthly averages									
		1919	1920	1921			1919	1920	1921
Jan.	.....	20.43	19.25	12.94	July	.....	20.82	19.00	....
Feb.	.....	17.34	19.05	....	Aug.	.....	22.51	19.00	....
Mch.	.....	15.05	18.49	....	Sept.	.....	22.10	18.75	....
Apr.	.....	15.23	19.23	....	Oct.	.....	21.66	16.53	....
May	.....	15.91	19.05	....	Nov.	.....	20.45	14.63	....
June	.....	17.53	19.00	....	Dec.	.....	18.55	13.18	....

LEAD						
Lead is quoted in cents per pound, New York delivery.						
Date			Average week ending			
Jan. 25.....	5.00		Dec. 20.....	4.82		
" 26.....	4.90		" 27.....	4.48		
" 27.....	4.90		Jan. 3.....	4.62		
" 28.....	4.85		" 10.....	4.78		
" 29.....	4.85		" 17.....	5.11		
" 30 Sunday			" 24.....	5.11		
" 31.....	4.85		" 31.....	4.89		
Monthly averages						
	1919	1920	1921	1919	1920	1921
Jan.	5.60	8.65	4.96	5.53	8.63
Feb.	5.13	8.88	5.78	9.03
Mch.	5.24	9.22	6.02	8.08
Apr.	5.05	8.78	6.40	7.28
May	5.04	8.55	6.76	6.37
June	5.32	8.43	7.12	4.76

ZINC

Zinc is quoted as spelter, standard Western brands, New York delivery,
in cents per pound.

Date			Average week ending	
Jan. 25.....	5.55	Dec. 20.....	5.89	
" 26.....	5.50	" 27.....	5.56	
" 27.....	5.45	Jan. 3.....	6.04	
" 28.....	5.35	" 10.....	6.00	
" 29.....	5.35	" 17.....	6.00	
" 30 Sunday		" 24.....	5.96	
" 31.....	5.35	" 31.....	5.42	

Monthly averages								
1919			1920			1921		
Jan.	7.44	9.56	5.86	July	7.78	8.18	8.31	.....
Feb.	6.71	9.15	.....	Aug.	7.81	8.31	.....	.....
Mch.	6.53	8.93	.....	Sept.	7.57	7.84	.....	.....
Apr.	6.49	8.76	.....	Oct.	7.82	7.50	.....	.....
May	6.43	8.07	.....	Nov.	8.12	6.78	.....	.....
June	6.91	7.92	.....	Dec.	8.69	6.03	.....	.....

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, according to quantity. Prices, in dollars per flask of 75 pounds.

Date		Jan. 18.....	50.00
Jan. 4.....	50.00	" 25.....	50.00
" 11.....	50.00	Feb. 1.....	50.00

Monthly averages							
	1919	1920	1921		1919	1920	1921
Jan.	103.75	89.00	50.00	July	100.00	88.00	....
Feb.	90.00	81.00	....	Aug.	103.00	85.00	....
Mch.	72.80	87.00	....	Sept.	102.60	75.00	....
Apr.	73.12	100.00	....	Oct.	86.00	71.00	....
May	84.80	87.00	....	Nov.	78.00	56.00	....
June	94.40	85.00	....	Dec.	95.00	52.50	....

MONEY AND MARKETS

There is a more confident feeling throughout the country and developments since the first of the year support improved sentiment. The gradual liquidation in many directions has materially lessened the strain on bank resources and the general credit position is improving, says 'Commerce Monthly'. However, the importance of export demand in the marketing of many American products makes it inevitable that present unstable financial conditions throughout a large part of the world will be reflected in the United States for some time to come. In addition, the readjustment from wartime price levels to those of a more normal character has been progressive and has affected different commodities in turn. While it has been practically completed in some lines, a further series of readjustments must necessarily occur in others before business can be properly re-aligned to new conditions and each has its bearing on the entire situation. The effect of these successive readjustments should neither be an occasion of general pessimism nor should undue optimism be engendered by unrelated improvement in special localities or lines of business.

The reserve ratio of the Federal reserve banks now stands at 48.1% as compared with 42.7% at the middle of October, when the fall requirements were at a maximum, and with 45.1% a year ago. Money rates, which continued at the levels previously current until well after the beginning of the new year, have now become somewhat easier. The ruling rate on commercial paper has declined from 8 to 7 1/4%, with a limited supply available and an active demand from country banks. Rates on bank acceptances have likewise declined sharply under the influence of liberal buying. The volume of time-loans on securities has been small, while the rate has declined from 7 1/2 to 7-6%. Call-loans made on the Stock Exchange ranged from 7 to 6%, while private sources were reported as having made loans as low as 4%.

Government requirements will be heavy and the needs of industry will continue large as liquidation progresses. Meanwhile, although bank borrowings from the reserve institutions have been reduced below the maximum reached last October, they are still substantially in excess of those of a year ago.

During the closing weeks of December, fluctuations in the principal exchanges were nominal. After the beginning of the new year, sterling advanced abruptly from 3.53 3/4 on January 3, to 3.77 1/4 on the 11th. Following this rapid recovery, it has declined somewhat, closing the period at 3.73 1/4. Other European exchanges with the exception of Italian lire, which were weak throughout, tended to follow the lead of sterling. The Scandinavian exchanges advanced steadily and substantially during the month, continuing the improvement which they experienced during the preceding period.

The pressure of bills against exports of grain and other raw materials has been relieved. The course of exchange during the period under review is indicated in the following table of rates for cable transfers:

		December		January	
		16-22	23-31	3-8	10-15
London	4 8665	High 3.5425	3.5450	3.6550	3.7787
		Low 3.4825	3.5050	3.5387	3.6675
Paris	0.1930	High 0.0612	0.0595	0.0601	0.0620
		Low 0.0586	0.0580	0.0581	0.0596
Italy	0.1930	High 0.0358	0.0349	0.0353	0.0354
		Low 0.0338	0.0332	0.0339	0.0345
Germany	0.2382	High 0.0140	0.0140	0.0140	0.0150
		Low 0.0136	0.0135	0.0131	0.0139
Spain	0.1930	High 0.1317	0.1390	0.1340	0.1360
		Low 0.1293	0.1295	0.1310	0.1320
Holland	0.4020	High 0.3140	0.3160	0.3212	0.3325
		Low 0.3048	0.3125	0.3145	0.3225
Denmark	0.2680	High 0.1525	0.1585	0.1680	0.1785
		Low 0.1510	0.1522	0.1555	0.1685

FOREIGN QUOTATIONS	
Foreign quotations on February 1 are as follows:	
Sterling, dollars:	Cable 3.82
	Demand 3.83
Francs, cents:	Cable 6.95
	Demand 6.97
Lire, cents:	Demand 3.64
Marks, cents	1.55

Eastern Metal Market

New York, January 26.

There is almost no activity in any of the markets. The price tendency is downward in most of them.

The copper market has turned dull and a little weaker. Prices have eased.

Prices of tin are lower, due largely to a sharp decline in London. Buying by dealers has been good.

The lead market is very quiet and slightly easier, but not weak.

Demand for zinc is insignificant and values are lower.

Antimony is a little higher.

Two metals, copper and tin, are now quoted lower in London than since 1913.

IRON AND STEEL

After four weeks of restricted operation, amounting in some cases to almost complete shut-downs, various independent steel companies are starting up on orders that will keep their plants going on a 50 % scale for two weeks or more.

Thus the Chicago district shows better operations than in several weeks, the independent companies running this week at 30 to 40 % of steel works and 50 to 60 % of blast-furnace capacity, while the Steel Corporation's finishing mills were at 80 to 85 %.

While the lowering of wages is much discussed, the steel companies are slow to act, the reductions thus far made affecting a relatively small minority of mill-workers.

The dullness of the pig-iron market has been somewhat relieved by sales amounting to about 12,000 tons of various grades in the Philadelphia district and transactions of moderate size in the Central West. Prices as low as \$27.50, Birmingham, have been done on a sale of 2000 tons to one company, but the usual quotation in the South is now \$30, which is \$2 lower than that prevailing a week earlier.

American exporters are actively canvassing home consumers as possible buyers of European steel and are also trying to sell such steel in distant markets, such as the Dutch East Indies. As yet home buyers are as indifferent to this foreign material as they are to American steel. German steel is offered in increasing amount, though sometimes hidden through handling by British, Belgian, or Dutch exporters.

COPPER

The market has turned weak and is easier than at any time this month. There was a fair demand the latter part of last week but it appears that there was some competition for the business offered which resulted in some cutting and therefore a withdrawal of buyers. Despite this, a fair business was done. Electrolytic copper is now quoted at 12.75 to 13c., New York, for prompt and January, with first-quarter delivery held at 13 to 13.25c. Lake copper is in light demand; it is quoted at 13.25c. for early delivery.

In the British market conditions are extremely poor with prices down below quotations in 1913, although the previous low point is stated to have been in March 1915.

TIN

The feature of the market is the sharp decline Monday and yesterday in the London market. Prices broke sharply on Monday, an average of £8 per ton, or back to the previous low point in 1915. In fact it is stated that higher prices than those now quoted prevailed in all of 1913 and early 1914. Yesterday spot standard fell to £164 per ton with future standard at £169 15s. and spot Straits at £187. This is a decline from last week of £9 in spot Straits and almost £16 in standard. In sympathy with this decline the New York market is lower, spot Straits being quoted yesterday

at 32.50c., New York, against 34.75c. a week ago. The market has been fairly active, dealers being the buyers. Consumers are still uninterested. From the buyer's point of view, the market has been a narrow one because there are few dealers ready to sell. A good volume of business has been done but the transactions have been put through quietly and all attractive offers have been quickly taken. The business done has consisted mostly of February-March delivery here, shipment-metal for that position being hard to purchase. Arrivals thus far this month have been 955 tons with 2110 tons reported afloat.

LEAD

This market is dull and the undertone is easy, but there are no signs of weakness. There is the ever-present possibility of softness due to imports if the London market declines sufficiently, but the strong tone of exchange is apparently neutralizing any decline there. Admittedly there has been good buying of lead recently and hence the quiet market now is natural. There is a comparative scarcity of prompt lead in the East which has resulted in some premiums on this position. The leading interest continues to quote 4.75c., New York and St. Louis, but the outside market now stands at 4.80c., St. Louis, or 5 to 5.10c., New York.

ZINC

There is a total absence of activity and prices are largely nominal. Domestic prime Western is quoted at 5.40c., St. Louis, or 5.85 to 5.90c., New York, but imported metal is quoted, duty paid, at around 5.50 to 5.60c., seaboard. The London market is being closely watched for its effect here. The possibility of foreign competition is a cloud on the horizon. Producers are not forcing the market and are selling only enough to keep their organizations intact, though some are pressing their product slightly. They claim there is no profit at present prices but a decided loss and are advocates of a tariff. Any sales made for importation are subject to a possible increase in the tariff.

ANTIMONY

The future shipment market is higher, according to advices from the Orient. Wholesale lots, duty paid, are as a result higher here at 5.50c., New York, with jobbing lots at 5.62½ to 5.75 cents.

ALUMINUM

The market is unchanged with the leading producer asking 28.30c. f.o.b. producer's plant for wholesale lots of virgin metal for early delivery, with other sellers asking 23.50 to 24.50c., New York, for the same brand.

ORES

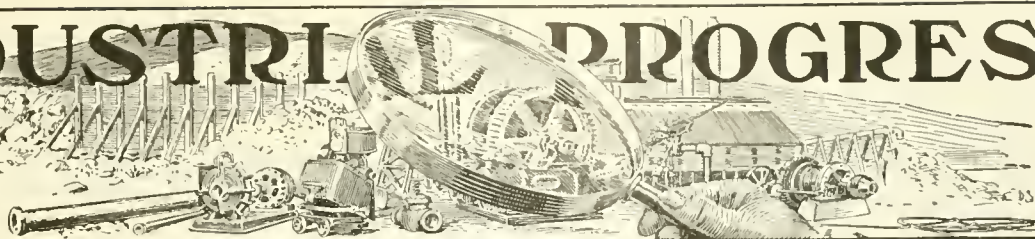
Tungsten: There is not much chance of a tariff on tungsten getting through the present session, according to sentiment in the trade. Market feeling is better, however, since those holders anxious to sell at \$3 per unit at the beginning of the year refuse this base now. The lowest price mentioned lately has been \$3.25, but buyers are not interested.

Molybdenum: The market is devoid of activity and prices are nominally unchanged.

Manganese: A spot lot of almost 2000 tons, probably resale, is understood to have been sold at 30c. per unit. The market is quiet with quotations from first hands nominal at 35 to 40c. per unit.

Manganese-Iron Alloys: Some British and American producers of ferro-manganese are quoting \$100, seaboard, and \$105, delivered, respectively, but no sales are recorded. Resale is reported done at \$90 to \$93, delivered, but some is held at \$95, point of shipment. Spiegeleisen is inactive at \$40 to \$45, furnace.

INDUSTRIAL PROGRESS



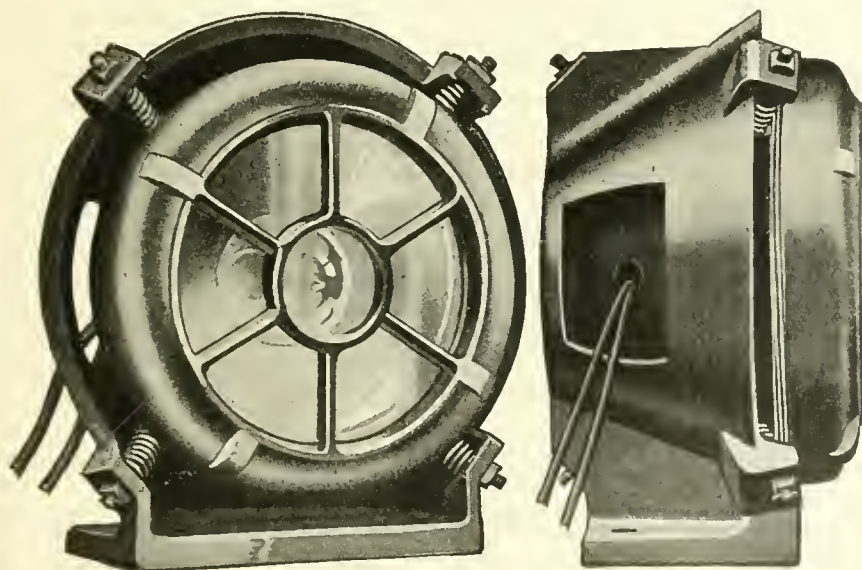
INFORMATION FURNISHED BY MANUFACTURERS

HEADLIGHTS FOR MINE-LOCOMOTIVES

Westinghouse mine-locomotive headlights have been designed to meet a demand for fixtures which are sufficiently rugged to stand up under the hardest possible operating conditions, and yet which carry the lamp on a spring suspension which will adequately protect the filament from breakage due to vibration and jars. The special features of these headlights which enable them to meet the above requirements are as follows:

1. The frame, case, and cover are made of high-grade cast-iron, heavy enough to withstand a terrific amount of abuse without injury.

2. The lens-holder is fitted to each case with a threaded



Headlights for Mine-Locomotives

joint, which, with rubber gaskets, tightly seals the headlight and makes it suitable for use in gaseous mines. A heavy cast-iron grid in front of the lens protects it from breakage.

3. The case (which contains the socket and lamp) is entirely suspended from six springs. These springs oppose each other and are always in tension. Thus, the spring-suspension is equally effective in all directions, assuring longest possible lamp life.

4. A socket is provided for medium-base lamps of from 23 to 94-watt capacity. These lamps should be of the concentrated filament type, which are made for use on circuits of from 105 to 130 volts. The headlights may, therefore, be used in multiple on 105 to 130-volt circuits, or two in series on 210 to 260-volt circuits.

5. The reflector is made of heavy copper, silver plated. Its parabolic shape ensures proper re-direction of the light rays.

Where headlights are to be operated on circuits of more than 260 volts a resistance is required. The resistance is

housed in a full cast-iron case and cover with open grid sides and top. This housing is very sturdy, being far superior in this respect to the sheet-steel housing usually furnished. Within the box are mounted two 50-watt, 600-ohm resistortubes. The resistance, therefore, is capable of dissipating 100 watts and has a total resistance of 1200 ohms.

SHOVELING MACHINES

'Mucking' is an important and costly detail of mine operation. A machine that will take the place of human hands will reduce greatly the cost of mining, provided the machine is more efficient and is able to spend its time on the job instead of in the repair shop. During the past few years shoveling machines have been brought much nearer to perfection. It is probable that within the next year there will be one or more efficient machines on the market.

Several machines suitable for use in cross-cuts and drifts in metal mines have been brought to our attention. Among them is the Armstrong shoveling machine, called the 'Shoveloder', made by the Lake Superior Loader Co., Duluth, Minnesota. The digging end of this machine consists of a scoop, or shovel, which is propelled into the muck-pile by air power, and then upward and back over the machine to the car to be loaded. It requires 6 ft. 10 in. of head-room. Reports have been received of its successful operation at several places.

The Hoar shovel, made by the National Iron Co., of Duluth, has the appearance of a miniature steam-shovel. It is said to be sturdy and fast in operation. One of these machines has been supplied to the United Comstock mine at Gold Hill, Nevada. A report of its performance will be forthcoming at a future date.

The McDermott twin-scoop loader, made by the Wellman-Seaver-Morgan Co., of Cleveland, Ohio, picks up rock by means of scoops on an endless chain, dumping onto a conveyor-belt, which delivers to the car at the rear.

There is in course of construction by the Denver Rock Drill Co. a shoveling machine invented by Howard Denis, for many years employed at the Empire mine, Grass Valley. This machine should be on the market within the next two or three months. It works on a different principle from those described above, having a series of rakes, or strong projections on an arm, which draw the rock onto a conveyor-belt. The conveyor-belt carries the rock back of the machine to the car. This machine has been demonstrated at the Empire mine and looks promising.

Within the last few weeks another machine has been demonstrated at the Empire mine, and plans for its manufacture are now afoot. This machine has no digging device, but consists essentially of a conveyor-belt which operates from the foot of the muck-pile. One or two men pull or shovel the rock onto the conveyor, which carries the rock

back of the machine to the car. A feature of this loader is the supplying of power for operating the conveyor-belt through the medium of the conveyor roller. At a recent test underground at the Empire mine, six cars were loaded and switched out in 75 minutes. A 16 cu. ft. car was loaded in one minute and fifty seconds on the surface, two men using shovels. This machine is the invention of R. E. Tremoureaux, formerly superintendent of the Champlon mine at Nevada City, California.

The above facts are set forth with a view to bringing before superintendents the advisability of the study of the shoveling machine. A letter to the manufacturers named will bring the necessary details. Monthly Bulletin of the Metals Exploration Co.

COMMERCIAL PARAGRAPHS

'Pump Data No. 53' is the title of the latest catalogue issued by the Aldrich Pump Co., of Allentown, Pa. Chilled-iron plungers and patented metallic packing are the particular products dealt with.

The Chicago Bridge & Iron Works, builder of elevated tanks, storage tanks, and all classes of plate-metal work, announces the opening of a sales office in San Francisco at 232 Rialto Bldg., of which Frank L. Cook will have charge.

George L. Hurst, formerly manager of the dredging department of the Bethlehem Shipbuilding Corp., Ltd., San Francisco, has resigned his position with that corporation and has taken up general mechanical engineering with offices in the Balboa building.

The Adamson Manufacturing Co., East Palestine, Ohio, has added a new department for manufacturing all kinds of storage, pneumatic and pressure tanks, welded pipe, battery-casings, evaporators, condensers, and a large line of arc-welded products.

Bulletin No. 15-C, recently issued by the National Tube Co., of Pittsburgh, is an unusually instructive treatise on special features of oil-well drilling equipment, much of which is included in the products manufactured by the company. An article by A. G. Wolf describes the 'Rotary Method of Well-Drilling', and points out the advantages and disadvantages of the method.

The Hardinge Company announces that on and after January 1, 1921, V. A. Stout, formerly in charge of its Salt Lake City office, becomes general sales manager and will be in its New York City offices at 120 Broadway. W. L. Penick, formerly in Salt Lake City and later in charge of the Hardinge Company's branch office at Spokane, comes to Salt Lake City again as district sales manager in charge of all the company's business in the West.

The Chicago Pneumatic Tool Co. announces the appointment of R. F. Eissler as assistant to the vice-president with headquarters in the company's new office building at 6 East 44th St., New York. W. C. Straub, formerly district manager of the New Orleans branch, has been appointed district manager of the Pittsburgh branch to succeed Mr. Eissler, and Ross Wyeth, formerly attached to the Pittsburgh branch, has been appointed district manager of the New Orleans branch to succeed Mr. Straub.

Irvin S. Thyle, a member of the A. H. Simpson Co. since its organization, has purchased the interests of A. H. Simpson in that company and also in the Triangle Engineering Co. Simpson is leaving the machinery business to engage in handling silica products. There will be no change in the business name of the Simpson company. Hereafter, in addition to overhauling and rebuilding machinery, the company will engage in the manufacture of screens, elevators, and transmission machinery.

Arrangements have been made by the Union Miniere du Haut Katanga with the Garred-Cavers Corporation, for the

use of its process, whereby pulverized coal is used to replace coke in blast-furnaces. The Union Miniere du Haut Katanga has placed orders for a 42-in. Fuller mill and a Fuller-Kenyon pump for the coal-preparation plant which will be used in connection with the above process at its copper smelter in the Belgian Congo. Licenses were secured from the Garred-Cavers Corporation some time ago by the Cerro de Pasco Copper Corporation, Peru, the International Nickel Co., and the Tennessee Copper Co., for the use of this process at their various smelters.

D. E. Sawyer has been re-elected general sales manager for the Pollak Steel Co. for the year 1921 and is located, as in the past, at the New York office of the company. S. K. Morrow, formerly manager of operations, is now manager of sales for the three plants, with offices at Cincinnati works. C. G. Talbott, formerly assistant manager of operations, is now manager of rolled products for the Marlon plant. A. C. Welhl, for several years superintendent of Cincinnati plant, is now general works manager in charge of operations and productions of the Cincinnati, Chicago, and Marlon plants. V. W. Prather, formerly cost auditor for Cincinnati plant, is now general cost auditor of three plants. R. A. Mitchell takes the position vacated by Mr. Welhl to become superintendent. J. H. Delekman becomes manager of materials and inspection of three plants. W. P. Woods becomes auditor and G. H. Tallaksen, superintendent of the Chicago plant.

Until recently it has been the custom to wash coal with jigs, cone-washers, or other methods, in the use of which advantage is taken of the difference in specific gravity between the refuse and the pure coal. In general these methods have proved satisfactory on the larger sizes, but are highly inefficient on the small material both with regard to cleanliness of product and saving of the fine coal. The Delster-Overstrom coal-washing table, manufactured by the Delster Concentrator Co., was designed to overcome the difficulties experienced with jigs and similar methods in the treatment of the smaller sizes of coal, especially that which will pass through a $\frac{1}{4}$ -in. perforation down to the finest dust. That this table is highly efficient on the class of material mentioned is attested by the fact that it is possible to eliminate 90% or better of the removable impurities, and at the same time reduce to a minimum the loss of good coal in the refuse.

'Oil-Line Pumps' is the title of a recent publication by the Aldrich Pump Co. The pumps discussed are of a group especially constructed and adapted for oil-line service, representing the latest developments in oil-pump design. In pumping oil through a pipe-line, the working-pressure is caused by the friction of the oil passing through the pipe. The velocity of the oil, its viscosity, and the length of the line and the size of the pipe determine the pressure. The safe working-load of the pipe used would correspond, of course, to the maximum pressure. These conditions are based upon a uniform flow of oil through the pipe. Any variation in velocity above or below a pre-determined rate causes unnecessary friction. Therefore, to force a maximum amount of oil with a given working-pressure, the velocity of the flow must be as nearly uniform as possible. The Aldrich quintuplex pump lends itself to this work, since the total variation in the discharge is only 7%, as compared to a variation of 23% from the triplex and a variation of 45.6% from the duplex double-acting pump. It is obvious that the quintuplex is a mechanical improvement on the other types. Moreover, it has the advantage in distributing the strains on the crankshaft, gearing, and connecting-rods in a uniform and regular way, thereby lessening shocks and undue wear. Each plunger has an independent and interchangeable fluid end whereby the size of the casting is greatly reduced, thus increasing the factor of safety in operating against the high pressures necessary.



T. A. RICKARD, - - - Editor

GOVERNOR HARDING of the Federal Reserve Board says that a general revival of sound business and industry is to be expected in the near future. We believe it.

RUMORS of a sale of four hundred million pounds of American copper to foreign consumers, principally Germany, by the Copper Producers Association, have been insistent in New York. The financing of this deal involves an outlay, it is said, of \$40,000,000, subscribed by a syndicate, the membership of which is not all in New York. This is an item of news that we hope to see confirmed, for it would go far toward relieving our market of its surplus stock of metal.

ON another page we celebrate Abraham Lincoln's birthday by publishing the full text of the oration delivered by Mr. Elihu Root on the occasion of the unveiling of the statue at Westminster last summer. It is fitting that Lincoln should be memorialized in front of the abbey in which lie the dead not only of England but of the forefathers of our republic, going back to a time that makes 1776 seem but yesterday. Moreover, if the American nation had given the world nothing more than the person and character of Abraham Lincoln it would have justified its separation from Great Britain.

NEW 'silver' coins, produced as a result of the passage of the Coinage Act of 1920, are already in circulation in Great Britain. They are similar in size and design to the old coins, but, owing to the large amount of nickel used in their manufacture, are considerably harder. The actual silver fineness of the new coins is 500 per 1000, as compared with 925 per 1000 in the old coins, which are being withdrawn from circulation. The last depreciation in the standard of British silver coins, to 250 parts per 1000, occurred during the reign of Edward VI, the restoration being effected during Queen Elizabeth's time.

WE went to press last week too soon to be able to make any reference to the celebration of the 35th birthday of our contemporary and neighbor, 'The Journal of Electricity'. A specially handsome issue of the 'Journal' and a sumptuous banquet served fittingly to commemorate the auspicious occasion. We were privileged to participate in the gastronomic part of the affair and to share the mental stimulus transmitted by a number of speeches from leaders of the electrical industry on

this Coast. The occasion and the speeches, however, represented a good deal more than the electrical business and profession, for both of them gave expression to the invincible optimism and the unfailing initiative of the leaders of industrial finance and engineering education in California. Mr. Robert Sibley, the talented editor of 'The Journal of Electricity', and his friends of the McGraw-Hill Publishing Company are to be congratulated on the event and upon the delightful way in which they gave it appropriate emphasis.

TRADITIONAL customs die hard in England, but sometimes the ceremonial observed on State occasions has to be modified to suit changing conditions. An instance of this was observed last month in London on the occasion of the Feast of the Epiphany when, according to annual custom, King George sent a couple of Court officials to the Chapel Royal, St. James's Palace, with gifts of gold, frankincense, and myrrh, to be handed over with the observance of proper ceremonial to the officiating dignitary. Now, gold is out of circulation in England, and the appearance of the Court officials at the high altar of the Chapel with a roll of 'Bradburys', as the English currency-notes of small denomination are called, would have been distinctly out of place. The ceremonial called for actual gold, real frankincense, and fragrant myrrh. The resins were obtained without difficulty, but to find the needed gold, some newly-minted sovereigns had to be withdrawn from the Bank of England. But frugality is the order of the day in England at the present time; and, at the conclusion of the ceremony, a roll of notes was exchanged for the gold, which was then duly returned to the vaults of the bank.

RELIEVED of the effusion of reportorial fancy, the bare facts concerning the career of a recent visitor in Seattle, as told in the 'Post-Intelligencer', make a remarkable story: Born in Ireland in 1847; emigrated to the United States a few years later; rounded the Horn in a sailing vessel and arrived in San Francisco about 1860; spent several years in Virginia City in the days when the Comstock was in its glory; sailed for Victoria, B. C., in 1874 and at once organized a party for the relief of miners in the Cassiar district, who were threatened with death from scurvy; 'came out' after two years and found diversion by running a store in Tombstone, Arizona, when the town offered a real thrill almost every hour; joined the vanguard to Dawson during the gold-rush of 1897; took \$100,000 out of Bonanza creek; settled later

at Nolan in the Koyukuk mining district, 480 miles by dog-team from Fairbanks; and now, at the age of 74, calls that home. This, gentle reader, is a skeleton of the story of Miss Nellie Cashman. We omitted the pronoun for a good reason. If richness of experience, if service to mankind, if the esteem of hundreds in a land like Alaska, where sham is at a discount and true worth counts most—if these things go to make a successful life, this excellent woman can look back over the past 70 years with the utmost satisfaction. She expects to return to Koyukuk to assume the position of deputy U. S. Marshal for her district. Hers is a career that might well be the envy of many a masculine sourdough.

REGULATIONS heretofore affecting the disposal of privileges in oil-producing areas have been temporarily suspended by the Canadian government. Apparently the unexpected discovery of oil near Fort Norman in the Mackenzie River region, indicating the possibility of a highly important oil-bearing terrain, has taken the Government off its feet; the authorities with commendable caution have 'called time' for a brief interval during which they expect to weigh the situation and determine what changes in the regulations are advisable. The large companies, who are willing and able to spend the money necessary to explore and develop the oil resources, urge that they be accorded some measure of protection from those who would file on adjoining claims with no intention of prospecting the ground but with the hope of extorting an unreasonable price in the event that oil be discovered. They feel that precedence should be given them as to land in the immediate vicinity of their drill-holes, and point out that the present regulations make no such provision. Some who oppose monopoly of resources by a few large private companies favor the nationalization of the oilfields and the construction of a government-owned system of pipe-lines. This would give the small operator an opportunity to drill under government lease, and to market his product economically. Another problem faced by the officials is that of controlling a possible stampede into the Northwest Territory next spring. Unless properly equipped and safeguarded, prospectors would risk suffering and even death in a journey northward during the brief summer season. The one well that gushed oil recently was capped immediately, so that there is no way of knowing what the output may be; nor is there assurance of the existence of anything more than an isolated oil-bearing formation, so that the present excitement may prove to be much ado about nothing, especially in view of the fact that the climate and isolation of the district prohibit exploitation on any but an ambitious and systematic scale.

AN excellent example of the useful perpetuation of a mining enterprise by the extension of its industrial activities to "fresh fields and pastures new" is given by the Yukon Gold Company. This undertaking was organized in 1908 to exploit the gold-bearing gravel of the Klondike river and its tributary creeks near Dawson, in the Yukon Territory. When it became apparent that the

ground was approaching exhaustion, the management began to look around for fresh alluvial deposits to which to apply the dredges. These were as good as new because the wearing parts had been replaced continually. Not long ago eight were at work in the Yukon, two in Alaska, and four in California. Now the two in Alaska are idle and three only are operating in California, namely, on the American, Trinity, and Yuba rivers. Thus ten dredges bought at pre-war prices and in good working shape were available. In 1918 the tin placers of the Malay Peninsula were suggested as deposits to which the dredges might be transferred profitably; so Messrs. Charles H. Munro and John F. Newsom were sent out at the head of a prospecting expedition, with such favorable results that four different areas have been acquired, by option or purchase, after careful drilling. Mr. Munro estimates that in the areas already selected there are 126 million cubic yards of gravel averaging 83 pounds of 73% tinstone per yard, representing a yield, in concentrate, of 75 million pounds of metallic tin, from which an operating profit of eighteen to twenty million dollars may be anticipated. Three dredges are in course of reconstruction and the first should start digging next June. The tables of the gold-saving apparatus are being replaced by sluices, the collecting area for saving the cassiterite being double that provided for arresting the gold. It looks like a good venture; certainly the engineers in charge are thoroughly competent. Moreover, dredging for tin in the Malay States is nothing new, the first work of the kind having been started nine years ago. Several English companies have done well, notably the Renong, under the guidance of Mr. E. T. McCarthy. Malaya produces 40% of the world's output of tin.

Institute Affairs

We publish a couple of letters, one from Virginia and the other from Colorado, on the management of the Institute. They are representative of other letters that we have received, but not for publication. In the main we agree with Mr. W. O. Borchardt, but we think him mistaken in identifying the management with a coterie in New York; on the contrary, it seems to us that ample evidence has been given during recent years of a desire to place Western members on the board of directors and even in the presidential chair. Unfortunately the chief financial centre of the United States is not centrally situated; likewise the national legislature meets in a city on the same side of the continent; so that the head office of the Institute is necessarily at a distance from many important mining and metallurgical centres. The directorate must be selected from those able to be in frequent attendance. As to the social activities, these also are shared chiefly by the eastern membership, because the annual meeting is usually held in New York, but an effort has been made, successfully, to distribute the summer meetings to other parts of the country. We agree with our correspondent that the talk of engineering efficiency is somewhat ludicrous in the face of the financial condition of the Institute, particularly in a year

during which an engineer world-famous for administrative ability has been the president of the Institute; but that only emphasizes the fact that the management is not in the hands of the presidents, whose tenure of office is short and who therefore are unable to make themselves felt in that regard, but in the hands of the secretary and his staff. All professional organizations in the last resort depend for their administration upon their secretary and those whom he selects to assist him. During Dr. Raymond's time we had an incomparable editor, but a poor business-man, as secretary. Since then we have had a poor editor, but, we thought until recently, an excellent man of business. Dr. Raymond ran the whole show: he was the real president, and those whom he selected to fill the titular post were actually only vice-presidents. Since his resignation, the presidents have been selected in a more systematic way and they have been more representative of the active part of the profession, but the growth of Institute membership and therefore the extension of its business affairs has been so great as to overtax those in direct control. Indeed, we belong to a minority that views the numerical bigness of the Institute with no enthusiasm. The contrast with the Mining and Metallurgical Society of America is instructive. This society in its effort to be select has succeeded in being exclusive, so that it has a membership of something like 300, in comparison with the 8000 in the Institute. Evidently opinions differ in the ratio of 80:3 as to who is fit for membership in a professional organization of mining and metallurgical engineers. We believe that both societies go to an extreme; in other words, that the American mining and metallurgical profession would be properly represented by about 3000 or 4000 men in good standing and suitable for membership in a professional organization that aimed to establish any sort of criteria for ability and character. It may be said that a generous comprehensiveness is more in accord with the democratic idea, and to that argument we can make no cheerful rejoinder, because we believe in widening the usefulness of any agency of education and we would regret to shut the door upon men, especially young men, who are seeking to make the very most of their opportunities; but, as a practical matter, it cannot be doubted that the swelling of the Institute by intensive solicitation, as has been the custom of late, leads to a membership so large that management becomes increasingly costly and inefficient. The complaint voiced by Mr. George E. Collins is echoed by others who have been impressed, or depressed, by the atmosphere of the head office. The lack of pleasant amenities and the failure to obtain personal courtesy at the office is, of course, a consequence of the mechanical methods inseparable from an overgrown organization. In the old days, a member had no difficulty in meeting Dr. Raymond, who welcomed him as a friend and made the visit memorable. In those days the Institute had 3000 members and published one volume per annum. A remedy is obvious. Let the Institute cease to attempt to cover the whole field of mining and metallurgy; there is an Iron and Steel Institute; why should not those engaged in the coal and iron branches of industry enroll them-

selves where they belong? Why should our Institute try so persistently to swell its membership from among those who ought to be members elsewhere? Mere bigness, mere numbers, means nothing and leads nowhere in particular. The solidarity of our Institute, and its usefulness, we believe, would gain by restriction to the mining of minerals other than coal and the metallurgy of metals other than iron, leaving those fields of activity to a society already organized to take care of them.

Lead Salts and Plagiarism

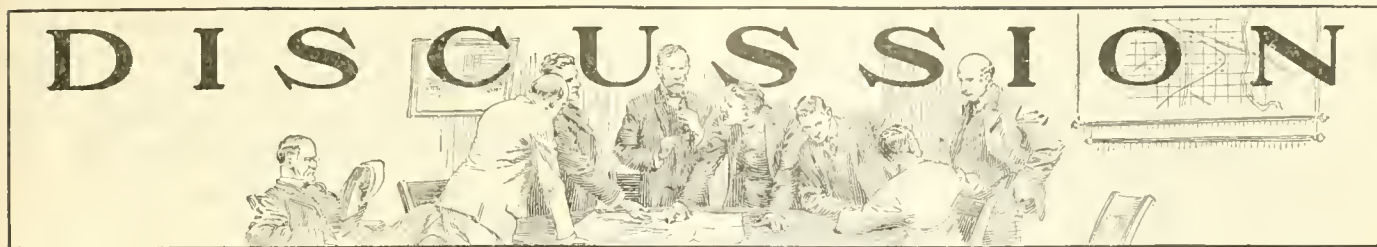
On another page of this issue we publish an article by Mr. Ralph W. Perry on 'Lead Salts in the Cyanidation of Silver Ores'. The subject has received attention in our previous issues, and several monographs of technical value have appeared, written by Messrs. M. W. von Bernewitz and G. H. Clevenger, among others. In this connection we regret the necessity for correcting a statement in Mr. Perry's paper, in which he credits Mr. W. A. Fahrenwald as the author of three conclusions with regard to the function of lead salts in the wet metallurgy of gold and silver. The chapter in Mr. Fahrenwald's book, 'The Cyanide Process', to which Mr. Perry refers, is an unblushing plagiarism of Mr. Clevenger's article, 'The Function of Lead Salts in Cyaniding', which appeared in our issue of October 24, 1914; and the credit for the conclusions belongs, therefore, to Mr. Clevenger and not to Mr. Fahrenwald. But Mr. Clevenger is not the only victim, for 'The Cyanide Process' is little more than an undigested collection of abstracts, for the most part unacknowledged, from Rose's 'Metallurgy of Gold', Collins' 'Metallurgy of Silver', MacFarren's 'Cyanide Practice', and the writings of other well-known authorities. It is regrettable, not only that credit should be denied where credit is due, but that engineers should be so easily misled into thinking that because material appears in book-form it is, necessarily, authoritative. Mr. Fahrenwald obtained his data from a number of reliable sources, but his book shows all the earmarks of having been prepared in a slovenly and unscientific manner; the copious extracts from well-known treatises have not even been edited to conform to a standard. Apart from the information correctly collated from reliable textbooks the significance of which has not been emasculated by crude and inexperienced paraphrasing, there is practically nothing of worth in the volume. Where an occasional sentence or paragraph is obviously original the construction is usually so involved as to make it meaningless. In other instances, where it must be admitted that the writer of the treatise speaks with an appearance of authority, it is found that he is repeating, almost word for word, the published opinions of experienced metallurgists. A glaring example of this appears in the chapter on 'Metallurgical Tests' where positive views on a particular phase of metallurgical work, published in the 'Mining and Scientific Press' in 1912, appear, almost word for word as in the original, as the personal opinions of the author of the book. Mr. Fahrenwald has grossly violated all the recognized laws of professional etiquette

Among technical investigators by the wholesale abstraction of the writings of others, usually indicative of careful research and unslashed effort, without giving credit where credit is due. A general acknowledgment of indebtedness in the preface savors of impertinence, and only serves to accentuate the fact that his unmitigated plagiarism was not unintentional. The copyrighting of such a book, as has been done by the author, is nothing less than a farce. We suggest to our readers and contributors that they disregard the volume as a serious contribution to the technical literature of the subject.

International Finance

Announcement is made that "foreign finance to the extent of \$150,000,000 or more is expected by Wall Street bankers to be well under way within the next six weeks". Our foreign trade in 1920, it is also announced, reached a total value of 13½ billion dollars, this being the largest in the country's history. Exports amounted to 8½ billions and imports to 5½ billions, leaving a trade balance of three billions. The Department of Commerce, which issues these statistics, states that exports were one-third greater than in 1913 and imports were nearly three times those of the ante-bellum period. We imported 429 millions of gold and exported 322 million dollars. During 1920 about 275 millions of European finance was consummated on the American money market, and at the present time about 375 millions of new European business is said to be in sight, not counting probable applications from Canada. The relative vigor of our money market is indicated by the prompt over-subscription to the Belgian loan of \$30,000,000. France is expected to make a large borrowing at an early date, and other European countries, including Switzerland and the Scandinavian kingdoms, are preparing to 'touch' us. Besides these demands there is every probability that as soon as the question of German reparations is settled there will be a funding of these obligations with a view to borrowing money upon them. Those who are well informed do not view with any alarm the prospect of the United States becoming a creditor to an increasing extent; on the contrary, provided the danger of another world conflagration or widespread revolution can be obviated, they consider it inevitable that we should accept the onus of the favorable position in which the War has placed us. At the present time we have, so to speak, both the money and the goods; this makes it impracticable for us to do business with our customers, the nations overseas, unless we extend our credit to them. We are in a position to do so. This country was never so sound financially. As compared with a year ago the reserves of the Federal Reserve system have increased from 45% to 48%. As Mr. W. P. G. Harding, governor of the Federal Reserve Board, has stated recently: "It is of vital importance that our trade with Europe be continued, and it is of scarcely less importance that trade relationships of other countries with Europe be maintained". If not, there will be a constant tendency toward the accumulation here of goods, principally raw materials, because countries that

formerly sold to Europe are unable now to do so, on account of Europe's inability to pay, and therefore are compelled to ship their products to the United States to sell for cash. The War Finance Corporation and the Edge Act are meant to expedite our foreign trade under the existing adverse conditions. It will be recalled that in December at Chicago a meeting of financiers approved a plan for a corporation to be organized under the Edge Act with a capital of 100 million dollars and able therefore, it is estimated, to finance a billion dollars' worth of business with Europe. Mr. Harding, of the Federal Reserve Board, is the president of this corporation, which is called the Foreign Trade Financing Corporation. This move was approved generally because it set aside the less desirable method of utilizing the resources of the Government for relieving the stringency in foreign credit, it being held rightly that Government aid usually leads to extravagance and waste on the part of the governments on the other side. Moreover, the cost of Federal assistance in this direction would fall eventually on the taxpayers, instead of such transactions being conducted by means of corporate enterprise, with all the care and economy inseparable from enlightened self-interest—in other words, on a business basis. As Mr. Herbert Hoover said: "We must face the fact that the economic ills we suffer arise from vicious economic circles that can be broken in one way only, that is, by the establishment of credits abroad, not the dangerous short-time credits in which we are already over-extended, but the long-time investment in reproductive enterprise abroad. The War has brought to us a great new phenomenon in our international economic life, that not for a long time to come, and perhaps never again, can we establish our foreign trade upon a balanced intake of commodities assisted by minor factors of remittance and service. If we would give full-time employment to our farmers, our laborers, and our business men, we must be prepared to invest abroad some part of the value of those surplus products." That is what Great Britain did on a large scale, much to her gain and prestige, in the years before 1914. It is true, soon after the Armistice, we heard the counsels of the parish pump, urging us to keep aloof from Europe and her distress, and to go forward alone in our wealth and prosperity as if we were an island in mid-ocean untouched by the sorry plight of the world at large. Those parochial counsels are now appraised at their value; they came from ignorance and they appealed only to ignorance. During the last twelve months the wiser advice of experienced economists and wide-awake financiers has put the issue squarely before us. We must buy if we want to sell; if our customer cannot pay in gold or its equivalent, we must extend credit; it is foolish to think that we can export unlimitedly while erecting a wall of tariffs against importation. These are the axioms of international trade. Moreover, existing conditions afford us a great opportunity to take a sagacious as well as a beneficent leadership in the restoration of the world's commerce, upon which in the end depends its political and social welfare. Let us fulfill our destiny with a clear head and a courageous spirit.



Institute Affairs

The Editor:

Sir—Your editorial and the letter entitled 'Institute Affairs' in your issue of January 22 are timely and to the point. It seems probable that a majority of the members of the Institute will agree with the opinions and recommendations therein contained, but this majority is generally silent at the very time when it is most important that it express itself, and consequently errors and abuses creep in that are eventually corrected by upheaval, whereas, taken in time, they could have been corrected without disturbance.

It is perhaps natural that the management of the affairs of the Institute should be largely in the hands of the older members, and particularly in those of such members as live in New York. Such men have generally gone high in the profession, and are sufficiently detached from the daily grind to be able to give time for what amounts to public service. The Institute is, however, now too large for them to give more than consultative and supervisory attention to its affairs, and all the details must be left to a paid staff.

While this system would appear to give the Institute the benefit of the best experience and most mature judgment in the direction of its affairs, it unfortunately seems to be one that lends itself to degeneration into management by a small group, which, although actuated by the best of motives, and believing itself to have the best interests of the Institute at heart, yet is quite out of touch with the mass of members, and governs in a way that is scarcely democratic. Apparently this governing group considers of the Institute as the primary entity, instead of remembering that it is merely the means to the ends which the members have associated themselves to effect. This habit of thought, which unconsciously puts the cart before the horse, similarly caused the leaders of Prussia to think in terms of the State instead of in terms of the associated individuals who alone gave that mechanism its reason for being.

"All that the rank and file want of the Institute is the regular publication of carefully edited technical papers." It seems impossible successfully to contradict this statement, and if it were to be taken literally by the management and applied as the criterion on any existing or projected activity of the Institute it seems probable that not only would present causes of discontent and objection vanish, but it would be found easily possible for the Institute to live within its income.

It is certainly inconsistent to campaign for more mem-

bers, so that the activities of the Institute can be "extended", while at the same time passing the hat to those already members to re-pay the loss resulting from present "over-extension". Disregarding the social activities, which are participated in by so small a minority of the members as to be immaterial, I believe it to be true that any member of the Institute can at the present time derive more benefit from subscription to three technical periodicals than from his membership. Most of the papers now published by the Institute, if they have real value, would be published, probably in better edited condition, by these technical periodicals, did the Institute not exist. The Institute's journal, 'Mining and Metallurgy', is not a technical magazine—it is a mistake.

The remark you credit to Captain J. C. Ray is certainly just, and your correspondent, quoted above, expresses the same opinion, that, before urging participation by engineers in public affairs as a palliative of the ills of society, the engineers should demonstrate their ability successfully and economically to manage their own professional public interests, even to their own satisfaction. This we are certainly not at present accomplishing through the medium of the Institute, but perhaps if we go at it the way we think we would run the Government if only given a chance, we may succeed, and may also gain experience that will be useful in the bigger job.

This thing of the importance of getting the engineers to show how well they could succeed in Government where the 'politician' is supposed to have failed, is being run into the ground, and is becoming a public joke. Before tackling the task of operating the United States, why not start with a single city, or even a State? Probably there is nowhere a greater concentration of engineers of all kinds per square mile or per capita than in New York City and State, but do we there see them demonstrating how well engineers individually and collectively can bring their influence to bear in support of efficiency and economy in government? Has not New York State just lost by "requested resignation" the services of its engineer Commissioner of Roads, who was also in charge of road-building for the A. E. F., in order to make a place for a professional politician whose present soft snap is to be abolished as a sop to retrenchment; and has anyone heard the deadly roar of the outraged associated engineers which might naturally have been expected to follow so raw a deal?

What is so often overlooked is that in a government such as ours all other qualifications for participation in public affairs are useless to the individual ambitious thus to shine unless he has them as additions to the primary

and major ability to guess what it is that the people want, and, by co-operation with others, secure it for them. The people never say beforehand what they want, and so the politician has to try to guess. If he guesses right and is able to secure action, he leads. If he guesses wrong he soon finds out. What is the use of condemning the politician? He gets results under conditions where most of us would fail.

Perhaps what we most need in the Institute is not the engineer in politics, but some politics applied to engineering. Maybe we do not make our wants properly known, and we need a politician who will guess what they are and get them for us. Perhaps if given a chance we might even take enough interest in our own affairs to fill out a questionnaire, the results of which would serve as a guide to the authorities of the Institute in the reconsideration of the functions and activities of the Institute which appears to be indicated.

W. O. BORCHERT.

Austinville, Virginia, January 27.

Institute Expenditure

The Editor:

Sir—I wish to associate myself, in the main, with the expression of 'A Member', and also with the editorial on this subject, in your issue of January 22.

I have heard on all sides numerous expressions which indicate that the Proceedings of the Institute are considered too voluminous; and I believe they would be more generally useful if they were condensed. I also agree in thinking that the magazine, 'Mining and Metallurgy', is not worth its cost.

As to the running expenses, it is perhaps easier for us in the precious-metal mining business, who have been struggling with adverse conditions for several years, to realize the necessity for strict economy than for those who have been surrounded by the prevailing atmosphere of New York extravagance. Yet I think that a more considerate and unselfish attitude on the part of those who conduct the affairs of the Institute might have been shown.

During a recent visit to New York I called at the offices of the Institute, mainly to evince interest in its affairs, but partly for two other purposes:

(1) To be identified, so as to cash bank-drafts which I had with me for expenses.

(2) To enquire the way to the office of your New York contemporary.

In (1) I was not successful, because neither the Secretary nor Assistant Secretary was there. In (2) I was equally unsuccessful, because none of the young ladies who were in charge of the office (and who did not appear to have much to do) had the least idea of the whereabouts of the office of the 'Engineering and Mining Journal' or how to get there. What is more, with one exception, they did not seem in the least to care. The attitude toward the visiting member seemed to resemble that of certain office-buildings which display conspicuous placards reading "Book Agents and Solicitors not ad-

mitted to this Building". The general air of lack of occupation and indifference was such as might naturally create an unfavorable impression on the mind of the out-of-town member whose contributions assist to maintain what, I fear, is an establishment better calculated to uphold the dignity of the Institute than to fulfil its real needs.

GEORGE E. COLLINS.

Denver, January 24.

On Prospecting

The Editor:

Sir—Referring to Mr. Everit in 'M. & S. P.' of January 8, page 41, will say it behooves me as a prospector to encourage the mining engineer and prospector to join hands; the time has come when the prospector needs assistance, and his first aid is the mining engineer. The old-timer may be a little rough and uncouth, yet be a congenial companion. The young student must give and take, and if he can make clear any given point, unless the old man's head runs up like a thumb, he will be grateful.

My experience has taught me that the young engineer who is willing to do things and has the courage of his convictions is an asset to the prospector. There is but little virgin country to be prospected in the United States, except, of course, the district of Alaska. I venture to say, however, the field is nearly as large as ever on account of the increased demand for the rare minerals and the thousands of prospects in every stage of development having fair geological futures. There is just as good picking for the experienced prospector and engineer as there was a few years ago for the tenderfoot. As has been said before in the 'M. & S. P.', the mining man must help to develop new mines. If we continue to mine we must dig.

A PROSPECTOR.

Congress Junction, Arizona, January 20.

MANGANESE DI-OXIDE is often used for neutralizing the green tint produced by the presence of iron in glass, according to a Bureau of Mines publication. Pre-war specifications usually required 80 to 85% of MnO_2 and less than 1% of iron. Carbonaceous pyrolusite is objectionable, but the silicious variety is permissible. Powdered ore is usually employed where the glass is made in pots, while the lump or granular variety is frequently employed when tanks are used for the melting. The amount of manganese di-oxide added varies from 2 to 15 lb. per 1000 lb. of sand in the batch. An ornamental black glass has been produced by adding about 3% of the ore to the glass mixture. Manganese di-oxide is also used in the preparation of purple glazes and enamels. Manganese di-oxide, either natural or artificial, is extensively used as a 'dryer' for linseed and other oils. The quantity added rarely exceeds 0.5% but it is stated that even this amount tends to darken the oil; this objection, however, does not hold in the case of certain salts of manganese, such as sulphate, borate, oxalate, resinate, and linoleate, which are also largely used.

Abraham Lincoln

The address delivered by Mr. Elihu Root on the occasion of the unveiling of the St. Gaudens statue, the gift of America to the British people, at Westminster, on July 28, 1920

Abraham Lincoln was born on February 12, 111 years ago, in a log cabin among the mountains of the State of Kentucky. He came into a frontier life of comparative poverty, labor, hardship, and rude adventure. He had little instruction and few books. He had no friends among the great and powerful of his time. An equal among equals in the crude simplicity of scattered communities on the borders of the wilderness, he rose above the common level by force of his own qualities. He was sent by his neighbors to the State Legislature, where he learned the rudiments of government. He was sent to the Congress at Washington, where he broadened his conceptions to national scope. He was admitted to the Bar, and won a high place as a successful and distinguished advocate. He became convinced of the wickedness of African slavery, that baleful institution which the defective humanity of our fathers permitted to be established in the American colonies. He declared his conviction that slavery was eternally wrong with power and insistence that compelled public attention. He gave voice to the awakened conscience of the North. He led in the struggle for freedom against slavery. Upon that issue he was elected President. In that cause, as President, he conducted a great war of four years' duration, in which millions of armed men were engaged. When in his wise judgment the time was ripe for it, then upon his own responsibility, in the exercise of his authority as commander-in-chief, invoking the support of his country, the considerate judgment of mankind, and the blessing of God upon his act, he set free the 3,000,000 slaves by his official proclamation, and dedicated the soil of America forever as the home of a united liberty-loving commonwealth. The act was accepted; it was effective; African slavery was ended; the war was won—for union and for freedom; and in the very hour of victory the great emancipator fell at the hand of a crazed fanatic.

It was not chance or favorable circumstances that achieved Lincoln's success. The struggle was long and desperate, and often appeared hopeless. He won through the possession of the noblest qualities of manhood. He was simple, honest, sincere, and unselfish. He had high courage for action and fortitude in adversity. Never for an instant did the thought of personal advantage compete with the interests of the public cause. He never faltered in the positive and unequivocal declaration of the wrong of slavery, but his sympathy with all his fellow-men was so genuine, his knowledge of human nature was so just, that he was able to lead his countrymen without dogmatism or imputation of assumed superiority. He carried the civil war to its successful conclusion with

inflexible determination; but the many evidences of his kindness of heart toward the people of the South and of his compassion for distress and suffering were the despair of many of his subordinates, and the effect of his humanity and considerate spirit upon the conduct of the war became one of the chief reasons why, when the war was over, North and South were able during the same generation to join again in friendship as citizens of a restored Union.

It would be difficult to conceive of a sharper contrast in all the incidental and immaterial things of life than existed between Lincoln and the statesmen whose statues stand in Parliament Square. He never set foot on British soil. His life was lived and his work was wholly done in a far distant land. He differed in manners and in habits of thought and speech. He never seemed to touch the life of Britain. Yet the contrast but emphasizes the significance of the statue standing where it does. Put aside superficial difference, accidental and unimportant, and Abraham Lincoln appears in the simple greatness of his life, his character, and his service to mankind, a representative of the deep and underlying qualities of his race—the qualities that great emergencies reveal, unchangingly the same in every continent; the qualities to which Britain owed her life in the terrible years of the last decade: the qualities that have made both Britain and America great. He was of English blood, and he has brought enduring honor to the name. Every child of English sires should learn the story and think with pride: "Of such stuff as this are we English made". He was of English speech. The English Bible and English Shakespeare, studied in the intervals of toil and by the flare of the log fire in the frontier cabin, were the bases of his education; and from them he gained, through greatness of heart and fine intelligence, the power of expression to give his Gettysburg address and his second inaugural a place among the masterpieces of English prose.

He was imbued with the conceptions of justice and liberty that the people of Britain had been working out in struggle and sacrifice since before Magna Charta—the conceptions for which Chatham and Burke and Franklin and Washington stood together, a century and a half ago, when the battle for British liberty was fought and won for Britain as well as for America on the other side of the Atlantic. These conceptions of justice and liberty have been the formative power that has brought all America, from the Atlantic to the Pacific, to order its life according to the course of the common law, to assert its popular sovereignty through representative govern-

nent—Britain's great gift to the political science of the world—and to establish the relation of individual citizenship to the State on the basis of inalienable rights which governments are established to secure. It is the identity of these fundamental conceptions in both countries which makes it impossible that in any great world emergency Britain and America can be on opposing sides. These conceptions of justice and liberty are the breath of life for both. While they prevail both nations will endure; if they perish both nations will die. These were Lincoln's inheritance, and when he declared that slavery was eternally wrong, and gave his life to end it, he was responding to impulses born in him from a long line of humble folk, as well in England as in America, who were themselves a product of the age-long struggles for the development of Anglo-Saxon freedom.

The true heart of Britain understood him while he lived. We remember the Lancashire workmen brought into poverty and suffering through lack of cotton. When the Emancipation Proclamation had dispelled all doubts as to the real nature of the struggle in America, 6000 of them met in a great hall in Manchester and sent to President Lincoln a message of sympathy and support. This was his answer:

"Under these circumstances, I cannot but regard your decisive utterances upon the question as an instance of sublime Christian heroism which has not been surpassed in any age or in any country. It is, indeed, an energetic and re-inspiring assurance of the inherent power of truth, and the ultimate and universal triumph of justice, humanity, and freedom. I do not doubt that the sentiments you have expressed will be sustained by your great nation; and, on the other hand, I have no hesitation in assuring you that they will excite admiration, esteem, and the most reciprocal feelings of friendship among the American people. I hail this interchange of sentiment, therefore, as an augury that, whatever else may happen, whatever misfortune may befall your country or my own, the peace and friendship which now exist between the two nations will be, as it shall be my desire to make them, perpetual."

We may disregard all the little prejudices and quarrels that result from casual friction and pinpricks and from outside misrepresentations and detraction, and rest upon Lincoln's unerring judgment of his countrymen and his race. We may be assured from him that, whenever trials come, whenever there is need for assurance of the inherent power of truth and the triumph of justice, humanity, and freedom, then peace and friendship between Britain and America will prove to be, as Lincoln desired to make them, perpetual. This man, full of sorrows, spoke not merely for the occasions and incidents of his own day. He expressed the deepest and holiest feelings of his race for all time. Listen to the words of his second inaugural:

"Fondly do we hope, fervently do we pray, that this mighty scourge of war may soon pass away. Yet, if God wills that it continue until all the wealth piled by the bondsman's 250 years of unrequited toil shall be sunk,

and until every drop of blood drawn by the lash—shall be paid by another drawn with the sword, as was said 75 years ago, so still it must be said: 'The judgments of the Lord are true and righteous altogether.' With malice toward none, with charity for all, with firmness in the right as God gives us to see the right, let us strive to finish the work we are in; to bind up the nation's wounds; to care for him who shall have borne the battle, and for his widow and for his orphan; to do all which may achieve and cherish a just and lasting peace among ourselves, and with all nations."

Consider this letter which he wrote to Mrs. Bixby, Boston:

"I have been shown on the files of the War Department a statement of the Adjutant General of Massachusetts that you are the mother of five sons who have died gloriously on the field of battle. I feel how weak and fruitless must be any word of mine which should attempt to beguile you from the grief of a loss so overwhelming; but I cannot refrain from tendering to you the consolation that may be found in the thanks of the Republic they died to save. I pray that our Heavenly Father may assuage the anguish of your bereavement, and leave only the cherished memory of the loved and lost, and the solemn pride that must be yours to have laid so costly a sacrifice upon the altar of freedom."

More than half a century has passed, but is this the voice of a stranger to the men and women of Britain in these later years? Because, under the direst tests of national character, in the valley of the shadow of death, the souls of both Britain and America, prove themselves of kin to the soul of Abraham Lincoln, friendship between us is safe; and the statue of Lincoln the American stands as of right before the old Abbey where sleep the great of Britain's history.

SULPHURIC ACID, according to the Bureau of Mines, is used for the following purposes: Dilute acid, that is, 60°B., 78% H_2SO_4 , or weaker, is used in the manufacture of superphosphates, ammonium sulphate, and sulphates of magnesium, aluminum, iron, zinc, and copper; in precipitating barium and calcium sulphate for chemical purposes; in the manufacture of various mineral and organic acids; in pickling sheet-iron for tinning and galvanizing; in the production of copper, zinc, silver, nickel, and gold; for various types of galvanic batteries, storage batteries, electroplating; in the manufacture of ether; in making and purifying many organic coloring matters; in making starch, syrup, and sugar; and in numerous other chemical and metallurgical operations. Concentrated acid, that is, acid 60°B., 78 to 100% H_2SO_4 , is used for purifying benzene, petroleum, paraffin oil, or other mineral oils; for manufacture of nitroglycerin, pyroxylin, nitrobenzene, picric acid, and various other nitric compounds and nitro ethers; and in the manufacture of fatty acids by distillation. Fuming acid (oleum) is used principally for the manufacture of various forms of explosives, certain organo-sulphuric acids, and in fortifying weaker acids.

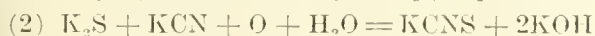
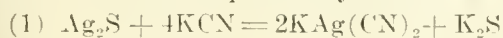
Lead Salts in the Cyanidation of Silver Ores

By Ralph W. Perry

INTRODUCTION. The beneficial action of lead salts in the cyanidation of gold ores was recognized shortly after the process was introduced on the Rand; and in 1893 J. S. MacArthur and C. J. Ellis obtained patents covering the use of these reagents in the cyanide process. At that time little advantage was gained from their use, for the reason that cyanidation was applied only to gold ores, but as soon as the process proved successful in extracting silver as well as gold the importance of using lead in some form in the solutions became apparent. It has since been employed generally in the treatment of silver ores; indeed, ores are rare in the treatment of which an increased extraction cannot be obtained from the use of lead salts. Generally where it is not used, the ore itself contains enough oxidized lead minerals to make further addition superfluous. No satisfactory explanation of the action of lead has yet been advanced.

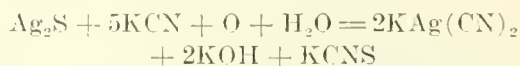
THE SOLUBLE-SULPHIDE THEORY. The value of lead salts was first believed to consist in their ability to pre-precipitate soluble sulphides from the solutions as insoluble lead sulphide, thus preventing the re-precipitation of silver already dissolved. This theory was conditional on the formation of soluble sulphides by the action of cyanide solutions on silver sulphide or other base-metal sulphides. Some doubt has been expressed by numerous authorities¹ as to the formation of soluble sulphides, and they have shown quite conclusively that soluble sulphides are rarely found in cyanide solutions. It would be most surprising if they could be detected in solutions containing the amount of silver and zinc that is usually present in plants using zinc precipitation. E. M. Hamilton states that they have been found in the effluent solutions from aluminum precipitation at Nipissing and Divisadero, owing probably to the reduction of thio-sulphates in the precipitation process.

The solution of silver from silver sulphide or from argentite, the form in which it is found most frequently in nature, is often expressed by the following equations:



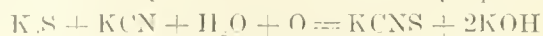
Since the reaction in the first equation is reversible, it would furnish a reasonable explanation of the action of lead salts, if it actually took place. Soluble sulphides can exist in cyanide solutions, depending on the strength of the solution and the amount of silver and sulphides present, but it does not seem reasonable to expect a solution of a given strength in cyanide to dissolve silver, and for the soluble sulphides formed then to precipitate it

from the same solution. It can be easily understood that a condition of equilibrium would be reached where no more silver could be dissolved and extraction would stop unless the strength of solution were changed, and either silver or the soluble sulphides were removed. The second equation explains why the continued solution of silver is possible with the same strength of solution through the continuous removal of the K_2S formed by its conversion to KCNS , but in the absence of any evidence of its existence it seems more reasonable to accept one equation only as explaining the reaction, that is:



In aerating the sand charges at the Homestake mine by blowing compressed air through them, thiosulphates are found in the effluent solutions if water washes follow the aeration; but sulphocyanates are found if cyanide solution is applied first. This conversion of thiosulphates to sulphocyanates would be expected, according to the same reaction as is employed in the quantitative determination of thiosulphates.² In my article I make no mention of soluble sulphides being found in either the water washes or the cyanide solutions used and they were presumably absent. Thiosulphates are often found in cyanide solutions and are probably produced directly from some of the base-metal sulphides in the ore, under the oxidizing conditions prevailing in cyanide work, but there seems to be no direct evidence that soluble sulphides are formed in the treatment of most ores. In the first test recorded in Table I, stannic sulphide was used and K_2S was present in the solutions at the end of agitation but was not detected earlier. I attribute this to the reduction of the stannic sulphide to the stannous form with the simultaneous liberation of the extra molecule of sulphur.

Notwithstanding the fact that the formation of soluble sulphides is generally doubted, this explanation is repeatedly employed to account for the use of lead salts. A. W. Fahrenwald³ says: "There are three reactions which prevent the formation of soluble sulphides. (1) Zinc taken into solution during precipitation seems to be as effective for their removal as lead added intentionally. (2) Sulphides rapidly form sulphocyanates with the simple alkaline cyanides which are always present, as



(3) Alkaline sulphides rapidly oxidize to thiosulphates, which in turn largely oxidize to sulphates; these cannot rise above a small proportion on account of the slight solubility of calcium sulphate." All of these three reac-

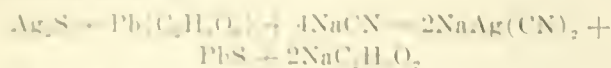
¹G. H. Clevenger, 'The Function of Lead Salts in the Cyanidation', 'M. & S. P.', October 24, 1914. E. M. Hamilton, 'Lead Acetate in the Cyanidation of Silver Ores', 'Mex. Min. Jour.', Vol. II, p. 47. J. R. Clennell, 'Lead Salts in Cyanide Treatment', 'E. & M. J.', Vol 94, p. 597.

²Allan J. Clark, 'Notes on Homestake Metallurgy', Trans. A. I. M. E., Vol. VII, p. 3.

³'The Cyanide Process', p. 125.

tions are based on the formation of soluble sulphides, the prevention of which they are supposed to explain.

Clemmell⁴ suggests that lead salts may act as an aid in the attack of cyanide solutions on silver according to the following equation:



Silver sulphide is soluble in cyanide solutions without the assistance of lead salts, but the action is much more rapid in the presence of either lead or mercury compounds, and is accompanied by the replacement of the silver by lead or mercury respectively.

Artificial silver sulphide, agitated for 20 hours with cyanide solution containing an excess of lead and mercury, dissolved much more rapidly than when these salts were absent.

The solutions assayed, at the end of agitation, as follows:

	Gm. per ton of solution
Cyanide solution alone	92
With lead acetate	192
With mercuric bichloride	183

THE ACTION OF INSOLUBLE SULPHIDES. The part played by natural sulphides in the precipitation of metals from their solutions has long been known and has been carefully investigated in relation to the formation of ore deposits and especially in the study of secondary enrichment.

Ernest Schuermann⁵ published the results of a series of experiments on the action of insoluble sulphides on solutions of other metals with the following conclusions:

"Many insoluble sulphides, freshly precipitated, transpose the solutions of other metallic salts. In some instances the action is quite rapid at ordinary temperatures, in others long continued heating (several hours) at 100° is necessary. PdS [palladium sulphide] is formed by action of PdCl₂ with sulphides of all the metals following in the series named below, but PdS is not transposed by solutions of the metals following. Silver salts form Ag₂S with sulphides of the metals following in the series, but not with sulphides of Pd, Hg, etc.: Pd, Hg, Ag, Cu, Bi, Cd, Sb, Sn, Pb, Zn, Ni, Co, Fe, As, Ti, and Mn."

Schuermann's investigations covered only the action of artificial sulphides in sulphate, chloride, and nitrate solutions, and it is at once apparent that if this order were the same in cyanide solutions, lead sulphide could be a precipitant of silver. It seemed probable that by determining the effect of artificial sulphides on silver-cyanide solutions, both with and without the presence of lead, some information might be obtained concerning the effect of lead salts in cyanidation. No attempt has been made to determine the position of the different metals in series further than to show the effect of the various sulphides on the silver in solution.

Table I

250 mg. of sulphide used in each test
250 cc. of solution used containing 100 gm. of silver per ton of solution
Time of agitation, eight hours.
250 mg. of lead acetate added when lead was used.

Analysis of solution at end of agitation				Silver pre- cipitated,
Sulphide used	Silver, gm. per ton	KCN, %	CaO, %	%
SnS ₂	2	0.13	0.02	98*
"	84.9	0.135	0.015	15.1†
"	39.1	0.135	0.115	60.9
"	66.7	0.120	0.110	33.3†
As ₂ S ₃	24.0	0.120	0.025	76.0
"	93.0	0.115	0.025	7.0†
"	76.2	0.120	0.120	23.8
"	93.6	0.080	0.120	6.4†
CuS	40.0	0.120	0.030	60.0
"	90.1	0.100	0.025	9.9†
"	64.3	0.100	0.130	35.7
"	90.0	0.125	0.130	10.0†
ZnS	61.0	0.100	0.005	39.0
"	95.0	0.080	0.005	5.0†
"	89.9	0.130	0.080	10.1
"	100.0	0.120	0.080	0.0†
Sb ₂ S ₃	67.7	0.130	0.050	32.3
"	92.5	0.125	0.050	7.5†
"	76.0	0.130	0.120	24.0
"	96.7	0.125	0.125	3.3†
NiS	88.0	0.060	0.045	12.0
"	94.5	0.125	0.050	5.5†
"	95.0	0.100	0.095	5.0
"	97.0	0.125	0.090	3.0†
FeS	92.2	0.125	0.040	7.8
"	95.8	0.140	0.040	4.2†
"	91.6	0.140	0.080	8.4
"	95.8	0.130	0.080	4.2†
MnS	90.9	0.130	0.015	9.1
"	100.0	0.135	0.010	0.0†
"	96.0	0.135	0.080	4.0
"	98.1	0.130	0.080	1.9†
Bi ₂ S ₃	100.0	0.120	0.030	0.0
"	100.0	0.125	0.030	0.0†
"	100.0	0.130	0.120	0.0
"	100.0	0.125	0.125	0.0†
PbS	100.0	0.125	0.125	0.0

*Both KCN and K₂S present in solution at end of agitation, both were absent in all the other tests.

†Lead acetate used.

Table I shows the results of these experiments which were made with solutions of different alkalinity, as it was early determined that the amount of lime in the solutions caused a great variation in the results. The effect of these sulphides is shown graphically in Fig. 1 and 2. The first of these shows the percentage of silver precipitated in solutions of low alkalinity, which I tried to keep below 0.02% CaO, but which was as high as 0.04% in the tests with antimony, nickel, and iron. Fig. 2 shows the percentage of precipitation in solutions of higher alkalinity, that is, varying from 0.08 to 0.13% CaO. The solution used was made up by dissolving AgCN₂ in sodium-cyanide solution, and contained no other substances than those mentioned in the table. The absence of soluble sulphides was proved before any of the sulphides were used. Different results may be ob-

⁴"Cyanide Handbook", p. 118.

⁵"Über die Verwandtschaft der Schwermetalle zum Schwefel", Liebig's 'Annalen 1888', pp. 249, 326.

tained by varying the amount of sulphide used, the quantity of silver or lead precipitated increasing as the amount of sulphide increases. Different results may be obtained by varying the length of the agitation-period and the quantity of air used. Compressed air was used in agitating the charges, the result being much stronger oxidation than ordinarily would be effected in practice. This probably accounts for the absence of sulphocyanates

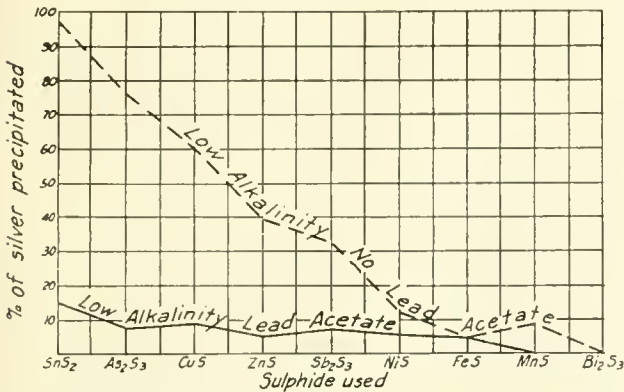


FIG. 1. EFFECT OF ARTIFICIAL SULPHIDES ON SILVER CYANIDE SOLUTIONS; KCN 0.013%, CaO 0.020%

in any of these tests, since sulphocyanates were invariably found when the same sulphides were in contact with the same solution without agitation. The effect of time on the amount of silver precipitated is marked; in some instances 85% is precipitated immediately by As_2S_3 , 71% of which is re-dissolved at the end of eight hours agitation.

No quantitative determinations of the lead precipitated were made, but its presence as sulphide was determined

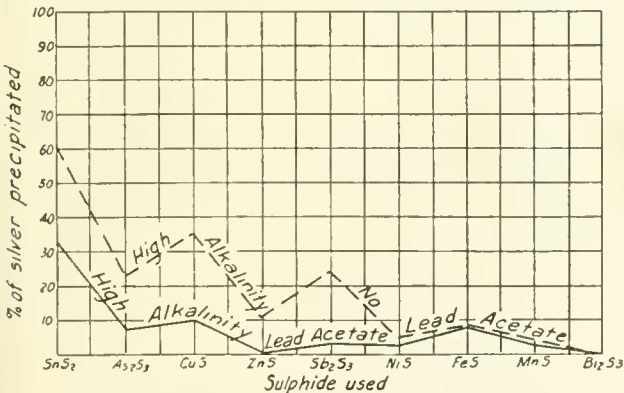


FIG. 2. EFFECT OF ARTIFICIAL SULPHIDES ON SILVER CYANIDE SOLUTIONS; KCN 0.130%, CaO 0.100%

qualitatively nearly always, although a large part of it was converted into the sulphate. FeS and MnS were almost completely changed to MnO_2 and Fe_2O_3 . The action of lead acetate in the solutions containing antimony and arsenic is rather puzzling. While it hinders the precipitation of silver, this does not seem to be caused by the preferential precipitation of lead, at least to the extent shown by the other sulphides. Very little silver can be detected in the precipitate and both As_2S_3 and Sb_2S_3 retain their characteristic color throughout the agitation,

whereas in the absence of lead acetate, they are immediately blackened by the silver sulphide precipitated. In the experiments with these sulphides it would seem that the presence of lead in the solutions tends to keep the silver in solution without entering into the reaction, although further investigation may show that lead is precipitated in sufficient quantity to retard the precipitation of silver. In practice lead salts have produced erratic results when used in the treatment of ores containing arsenic and antimony and at times their use has been considered a detriment rather than a benefit.

ZINC IN CYANIDE SOLUTIONS. It is a matter of common experience that extraction is generally lower with working solutions than with fresh solutions, especially where precipitation of zinc is used, and in some instances the effect of zinc on the extraction has been so deleterious that other methods of precipitation have had to be em-

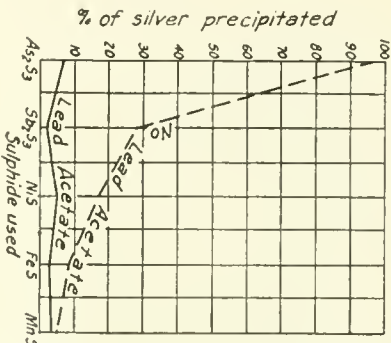


FIG. 3. EFFECT OF ARTIFICIAL SULPHIDES ON SILVER CYANIDE SOLUTIONS CONTAINING ZINC

ployed. The effect of sundry sulphides added to solutions containing zinc are shown in Table II and in Fig. 3.

Table II

250 mg. sulphide used in each test.
250 cc. of solution, 0.120 % KCN, 0.100 % CaO, and 81.5 gm. silver per ton and 250 gm. zinc per ton.
Time of agitation, eight hours.
250 mg. lead acetate added when lead was used.

Sulphide used	Silver gm. per ton at end of agitation	Silver precipitated %
As_2S_3	2.0	97.8
"	76.0	6.7*
Sb_2S_3	58.5	28.0
"	80.0	1.8*
NiS	67.2	17.8
"	77.0	5.5*
FeS	74.2	9.2
"	78.5	3.6*
MnS	77.0	5.5
"	78.0	4.2*

*Lead acetate used.

It was found impossible to obtain satisfactory extraction on zinc at Nipissing and elsewhere; this led to the adoption of precipitation on aluminum. E. M. Hamilton, in writing of the so-called fouling of solutions, refers to this action of zinc: "The zinc derived from precipitation seems not to effect extraction to any appreciable extent in the majority of instances, but there are cases, especially when treating ores containing antimony and arsenic,

where the presence of zinc lowers the extraction of the silver as much as 10%, and in a less degree that of gold. When zinc in solution is found to have this effect, lead in solution will often act similarly, and the addition of lead salts may have to be avoided. The writer has, however, recently come across several instances where the presence of zinc from zinc precipitation was distinctly detrimental to silver extraction, though the addition of litharge was beneficial. The presence of copper in the solution has the same detrimental effect on extraction, according to some observers, whereas many others have denied it. The action is probably the same, that is, the precipitation of CuS by some of the natural sulphides in the ore, the CuS precipitated being a more active precipitant of silver than the natural sulphides. This precipitation of CuS has not been proved experimentally, and in view of the fact that H₂S is not a precipitant of copper in cyanide solution, the above may not be a true explanation of the action of copper in cyanide solution, although there is no question in regard to zinc.

It has been generally understood that zinc plays the rôle popularly assigned to lead, namely, that of removing soluble sulphides from the solution; but freshly precipitated zinc sulphide is anything but harmless in a silver-bearing cyanide solution unless lead is present in some form, and in solutions of low alkalinity is an active precipitant of silver. Of course if it is not in excess it acts like the soluble sulphides, retarding the solution of silver until the silver sulphide has been decomposed by the cyanide solution and the sulphur molecule removed either by oxidation or combination with the cyanide. The following tests show that much of the silver precipitated by zinc sulphide can be recovered by further treatment.

0.5 gm. ZnS used.
1000 cc. solution containing 128 gm. of silver per ton.
24 hr. agitation.

	KCN in solution %	CaO %	Silver precipitated, %
(1)	0.08	0.130	24.2
(2)	0.08	0.040	89.0

These solutions were strengthened by the addition of cyanide and lime to 0.30% KCN and 0.130% CaO, and agitated for 16 hours more, at the end of which time they assayed 116 and 87 gm. of silver respectively.

The failure of solution containing zinc to give the same extraction as fresh solution would seem to be due to the action of insoluble sulphides in precipitating zinc sulphides, these natural sulphides being inert toward silver.

NATURAL SULPHIDES. Owing to the difficulty of securing suitable natural sulphides for experimental purposes, no work has been done along this line. It would not be reasonable to expect as marked effects from natural sulphides as from the artificial forms, but it has been proved that they do have this effect in their sulphate, chloride, and nitrate solutions.

A long series of tests given in the article referred to showed that sphalerite will precipitate lead, silver, and

copper from these solutions. A sample of ore from the Prieta mine, at Parral, Mexico, containing 6% zinc, 4% lead, and 350 gm. silver per ton in a solution of low alkalinity precipitated over 50% of the silver from a solution carrying 200 gm. of silver per ton. Further tests with the same ore gave the following results:

25 gm. ore used.
250 cc. solution containing 98.5 gm. per ton.
24 hr. agitation.

	Cyanide solution KCN, % CaO, %		Silver in solution at end of agi- tation, gm.	Silver pre- cipitated, %
(1)	0.13	0.08	87	11.6
(2)*	0.13	0.08	98.5	0
(3)*	0.13	0.04	98.5	0

*Lead acetate added.

By using fresh cyanide solution and an excess of lead acetate an extraction of over 40% of the silver could be obtained from this ore. It is probable that most sulphides have some ability to precipitate silver from cyanide solutions, especially after a certain concentration in silver is reached. This would explain why an increased extraction is generally obtained by a change of solutions or even by the dilution of the solution in use.

CONCLUSIONS. Lead salts apparently have three distinct functions in the cyanidation of silver ores.

(1) By aiding in the dissolving of silver through the replacement of the silver atom in silver sulphide by lead.

(2) By being precipitated by various sulphides in preference to silver; the lead sulphide is inert toward silver. It is doubtful if lead sulphide is always inert, as lead sulphide in contact with silver-cyanide solution without agitation will produce some precipitation.

(3) By being precipitated by some sulphides in preference to zinc, which sulphide is an active precipitant of silver.

Since comparatively small amounts of lead salts are required it is probable that their action is similar to sulphide filming as practised in flotation except that in cyanidation the filming is done by the precipitation of PbS and not by the combination of sulphur with the mineral.

Evidently there are two opposing forces operating at the same time, namely, the ability of a cyanide solution to dissolve silver sulphide and the tendency of various sulphides to precipitate silver from a cyanide solution. These two forces are well shown by the action of cyanide on the Prieta ore mentioned above, while 40 to 50% of the silver in this ore can be dissolved by cyanide, if it be treated with cyanide solution containing silver in appreciable quantity, more silver is precipitated than is dissolved.

It has often been asserted that lead salts serve to reduce the consumption of cyanide by combining with part or all of the sulphur that otherwise would form sulphocyanates at the expense of the cyanide. While they undoubtedly do lessen the consumption of cyanide to an extent, it is apparent that this is only done at an economic loss on account of the greater amount of lead salts used.

©Julian and Smart, 'Cyaniding Gold and Silver Ores', p. 113.

Lead acetate, $\text{Pb}(\text{C}_2\text{H}_3\text{O}_2)_2 \cdot 3\text{H}_2\text{O}$, has a molecular weight of 379 as compared with 49 for NaCN, and 7.7 lb. is required to combine with the same amount of sulphur as would be required by one pound of NaCN. If the cheaper PbO is used, 4.5 lb. is required as compared with one pound of NaCN, in either case costing more than the cyanide required to form sulphocyanate.

Some operators prefer litharge to lead acetate; it may be that the preference springs from the practice of adding litharge at an earlier stage in the treatment than is customary with lead acetate. To secure results from litharge, it must be ground in intimate contact with the ore and is therefore generally added in the tube-mill, while lead acetate is more often added during agitation. It seems logical to have small amounts of lead salts present during the entire treatment and especially from the first contact of the solution with the ore, as its addition later on serves principally to aid in dissolving silver that has already been precipitated at an earlier stage.

It was noted by Julian and Smart⁷ that minerals taken from different localities vary greatly in the way they are affected by cyanide solutions, and the sulphides from different mines will probably react differently with the silver in solution also. A careful separation of the various sulphides in an ore, and observation of their action on silver cyanide solutions, both with and without lead salts, should be of much importance in determining the best method of treatment.

Heap-Leaching of Copper Ore at Bisbee

Joseph Irving Jr. recently read a paper before the Bisbee chapter of the American Association of Engineers in which he described the method that will be used by the Copper Queen Branch of the Phelps Dodge Corporation in leaching the ore being mined by steam-shovel methods at Sacramento Hill. The following is quoted from his paper:

In order to prove out sundry smaller experiments a 10,000-ton heap was built at the foot of Sacramento hill and leached continuously for three years and three months. An average of all the samples showed that an extraction of 73% had been made in this time, which compared favorably with the estimated 80% extraction in five years.

One side of the heap, where proper oxidation had taken place, showed extraction of 90% in three years. In laying out this heap no attempt was made to crush the ore, the larger pieces, which naturally rolled to the bottom as the heap was being built, were used to build culverts and drains, and this brought them closer to the oxidizing influence of the atmosphere. This caused them to yield their copper about as fast as the smaller pieces near the top.

The method used was the simple ferrie-sulphate process, that is, the solution from the precipitating plant was pumped to the top of the heap and allowed to percolate downward through the heap, being enriched in

copper during its course and being drained from the bottom into the precipitating plant, where its copper content was recovered by precipitating on scrap-iron. The cycle was then repeated.

This was the first successful attempt at heap-leaching in the United States. A number of important innovations have been developed that will greatly shorten the period of treatment of low-grade ores by this method. It has been pointed out that the main defect of this method is the long period of treatment required, which is quite true, but when it is considered that leaching operations can be started as soon as a few tons of ore has been mined and laid out, and that there is no initial expense for crushing and leaching-plant, and that the extraction in the first year is nearly always about half of what it will be in five years, the advantages soon outweigh the one main disadvantage.

At Don Luis the first of the new large heaps is being laid out, 3,000,000 tons of ore, with an area of 2000 by 750 ft., and a depth averaging from 9 to 52 ft. An interesting feature of the Bisbee scheme is the new precipitating plant, which will be the first 'iron' precipitating plant in which all the operations will be done mechanically instead of by hand labor. The solution will flow by gravity through 12 Dorr precipitating-tanks; it will then be pumped back to the top of the heap. The copper precipitated will be washed free of the iron by agitating in the tank for a short period, after which the copper precipitated will be allowed to settle in the bottom of the tank. The Dorr mechanism in the tank is then lowered and rotated slowly, the discharge plug in the centre of the bottom of the tank opened, and the copper precipitate discharged. The precipitate goes to a Dorr classifier, where the coarse copper is separated from the fine. The coarse copper is deposited on a drying-floor to dry before shipment, and the fine goes to a Dorr thickener, the overflow solution from which is returned to the precipitating tanks, while the thickened solution is discharged through Dorr pumps to the various sections of the drying-floor. The iron necessary for the operation of the plant is unloaded from the railroad-cars and loaded into the precipitating-tanks by a five-ton gantry crane.

Two men will operate the plant, where a plant of the ordinary kind would require at least ten or twelve men. All the dirty and unpleasant work will be eliminated.

THE most notable new mining development of the year in Idaho was in the phosphate fields in the south-eastern corner of the State, according to Robert N. Bell. This interesting field of the most essential agricultural fertilizer mineral, has been the subject of elaborate study in recent years by the officials of the U. S. Geological Survey. This study resulted in the publication of a number of well illustrated bulletins and recently the preparation of a professional paper now nearing completion, by George R. Mansfield, who estimates a mineable resource, in this limited area of the great western phosphate field, to be 5,000,000,000 tons of 70% tri-calcium phosphate.

⁷'Cyaniding Gold and Silver Ores', p. 115.

Karl Eilers v. Guggenheims

Office of American Smelting and Refining Company,
120 Broadway

New York, January 20, 1921.

Dear Sir:

There is enclosed herewith the regular notice of annual meeting of stockholders.

There is also enclosed, as heretofore, the customary form of proxy, which you are requested to sign and return in the accompanying envelope, if you cannot be present at the meeting in person.

In former years, it has never been necessary to add anything to the simple request for proxies as made above. It should be, and doubtless is, unnecessary to say anything now. Since, however, those who have been charged with the management of the Company for years past, to the present time, have very recently been attacked by one of the Company's discharged employees, who is seeking proxies for himself, it is proper that a statement should be made in fairness both to the directors and to the stockholders of the Company. Such a statement is accordingly appended.

I desire to add (in reference to the criticism made of my stock holdings) that my wife and myself own stock in the Company of the par value of over \$2,800,000, and bonds to the extent of \$300,000—a total of over \$3,000,000.

Respectfully,

SIMON GUGGENHEIM,

President.

STATEMENT ON BEHALF OF THE DIRECTORS OF THE AMERICAN SMELTING AND REFINING COMPANY

The undersigned directors of the American Smelting and Refining Company desire to make a statement to the stockholders of the pertinent facts with regard to the matters involved in the attack recently made upon the present management of the Company.

The attack is made by Mr. Karl Eilers, who is asking proxies for himself and a single associate, which will give them power to elect the entire Board of Directors. IN EFFECT, THE REQUEST IS FOR A BLANKET AUTHORIZATION TO MR. EILERS TO CREATE AN ENTIRELY NEW ORGANIZATION, SUBJECT TO HIS SOLE DOMINATION.

Mr. Eilers was for many years a director, and first became a Vice-President in November, 1916. After much friction, it became manifest that, for the welfare of the Company, his association in its management would have to be terminated. He was accordingly removed from office and dropped from the directorate at the annual election of last year. It is perhaps natural that this action should have aroused bitterness and resentment on his part, and that his anger should be principally directed against President Guggenheim and his brothers. The feeling thus engendered is sufficient to account for

his present attitude and for the recklessness of his statements.

In December last, Mr. Eilers started his campaign for stockholders' votes by bringing a wholly unnecessary and unjustifiable suit against the Company for a writ of mandamus to permit him to examine the stock books and take off the names and addresses of the stockholders and the number of shares held by each, alleging that such permission had been refused, when in fact he had been freely given access to the books and had spent days in examining them through a representative before the suit was brought. While the Court promptly denied the writ and dismissed the petition, after the matter was heard, the apparent object was accomplished, namely, wide newspaper publicity to the various charges of misconduct or mismanagement which he had injected into his petition. These charges he could not be called upon to prove in the application heard by the Court, and they could only be met by a denial and answer on the part of the Company setting forth the facts.

A pamphlet giving the entire Court proceeding has been sent to all stockholders, a careful reading of which is again suggested.

If you will analyze the statements or charges made, in the light of the surrounding circumstances and of the facts set forth in the answering affidavit of Mr. Newhouse, Chairman of the Board, contained in the pamphlet mentioned, you will have no difficulty in perceiving how essentially groundless and unsubstantial and inherently improbable they are. For the most part, they turn on mere matters of opinion, and in this respect they mean no more than that Mr. Eilers sets his individual opinion against the opinion of the twenty odd men constituting the Company's Board of Directors. While Mr. Eilers now inveighs against the alleged undue and baneful influence of the "Guggenheims", it is to be noted that throughout the long period of his service with the Company, the stockholders or the public never heard a word of criticism from him, and that it was not until after his connection with the management had ceased, in fact not until he began his campaign for proxies, that his complaints were made.

Referring to the several accusations in detail:

(1) The suggestion or intimation (it is not definitely charged) that the Messrs. Guggenheim, or some of them, have been overpaid by the Company or have received large salaries is utterly without foundation. Aside from the President, no member of the Guggenheim family now receives any salary whatever, or has received a salary since January, 1919. The salary received by the President is less by \$10,000 than Mr. Eilers enjoyed at the time of his discharge. The salaries paid in former years to such of the Messrs. Guggenheim as held office in the Company were always less than salaries paid at the same time to other officers. Such salaries as they did receive

were reduced on their own motion in times of financial stringency. The Messrs. Guggenheim never participated in any of the bonuses paid to all other employees and officers, including Mr. Eilers.

(2) The charges that the Messrs. Guggenheim have sought to manage the Company, in disregard of the interests of the stockholders, in order to serve other and adverse interests, and have promoted enterprises which should have been developed for the Company's account, are embodied in three specifications. As these charges are specific, it is a simple matter to refute them absolutely.

(a) The falsity of the charge that the Company was not permitted to acquire a certain Bolivian tin property examined by it because it was wanted by Guggenheim Brothers, who did acquire it, is shown by the simple fact that no tin or other property ever considered or examined by the Company has been acquired by the Guggenheims.

(b) With reference to the Premier Gold Mining Property: So far from the Company having been forced to give up to Guggenheim Brothers one-half of its option on a quarter interest in the property, the Company solicited the firm named to take a half of its option off its hands, for the reason that, while it was willing to take a chance on a one-eighth interest, it wanted for financial reasons to limit its investment and its risk to that amount. No developments thus far have caused us to question the wisdom of the action taken.

(c) It is charged that the Messrs. Guggenheim promoted mining properties not for the Company's account but for their own benefit. When such enterprises were undertaken, the outcome was problematical in the extreme, the capital required was very large, and the risks of loss were very great. Neither this Company, nor any other company, unless specially formed for a distinctly speculative venture, would have thought of risking its resources, credit, and the property of its shareholders, in such distant and hazardous enterprises. It is doubtful if any one but Mr. Eilers could think otherwise. The responsible officials of the Company never even contemplated such action. They would have been truly unworthy of their trust had they done so. This Company is distinctly of the class enjoying what is practically a steady manufacturing business. It is not a speculative promoting company. On the other hand, the eventually successful development of the properties by the Messrs. Guggenheim and their associates has greatly benefited this Company through the valuable new smelting and refining business which thus came to it.

(3) The charges which have to do with the marketing of copper (the word "gambling" is used) are incorrect, misleading and grossly unjust. The essential facts are stated by Mr. Newhouse in the pamphlet mentioned, to which you are again referred for an account of what was actually done. What Mr. Eilers says on the subject is an illustration of the inconsistencies into which he is led in his desire to convict the management of some wrongdoing. In his petition, he complains loudly of alleged

losses resulting from a course of action compelled by the existence of certain selling contracts, while in his latest statement he complains, just as loudly, of alleged losses resulting from the termination of those contracts, although such termination will permit the Company to follow a selling policy which he advocated in his earlier statement, and which it could not otherwise pursue.

Any losses in marketing copper were not due to any change of policy, but were the inevitable outcome of the Sales Agency arrangement under the abnormal and unexpected conditions created by the war. The basic vice of the Sales Agency as developed by war conditions was the pro-rata feature, under which this Company could only sell its copper in the same proportion that the Mining Companies sold their copper. This feature the Mining Companies, though repeatedly urged by this Company, would never consent to forego. In justice to the Mining Companies, their right to this provision could not be questioned; in justice to the Smelting Company, the effect of that provision could only be avoided by the termination of the Agency.

At the start of the Agency, the Mining Companies (Utah, Ray, Chino, Nevada Consolidated, and much later Braden, Kennecott, Cerro de Pasco, and Chile) were all new and small mines, and the amount of copper belonging to this Company constituted a large percentage of the total copper in the Agency. The Mining Companies in the Agency have since become among the largest producers in the world, and by the time the war broke out, the proportion of the copper in the Agency owned by this Company (notwithstanding it had also increased) was only about one-fifth of the total amount available for sale. The Smelting Company was under contract obligation to sell to the best advantage. Obviously, the opinion of the owners of four-fifths of the copper should control the policy of selling, or the Smelting Company might be the subject of a heavy claim for damage.

The Mining Companies, having only the cost of production, wished to withhold from sale on a dull market, and to sell largely when the price met their opinion of the future.

The Smelting Company sought, not to make a profit in the buying and selling of copper, but to make its profit out of smelting and refining, and was anxious to sell its copper at the price it paid for it in the ore.

Gradually, the Mining Companies came to think that the Smelting Company's interest in selling its own copper might unfavorably affect the Smelting Company's attitude in seeking to get the best price.

On the other hand, the Smelting Company felt that it was often unable to sell its own copper, because the Mining Companies took a different view of the future of the market, and also often because in dull periods the market would not consume the total amount of copper controlled by the Agency.

As the result of this duality of interest, it became necessary to terminate the Agency. As a matter of fact, of their own motion, some of the most important members of the Agency themselves took the initiative and with-

drew because of a conviction that the conflict of interest above described could not be avoided. The decision to terminate the Agency, as to the remaining members, was reached by the entire Board (excluding the Guggenheims) after most careful and prolonged study and investigation.

The undersigned wish to emphasize that every member of the Guggenheim family studiously avoided influencing the opinion of the remaining directors, refrained from the expression of any opinion, and absented themselves from the meeting at which the question was decided, in order that no charge of a conflict of interest on their part could possibly be made.

CONCLUSION.

It is worthy of note that even Mr. Eilers does not question the fundamental soundness of the Company's position, the assured permanency of its business, its industrial and commercial stability, its enviable credit, and its assured earning power under normal conditions. This Company, like virtually every other company the country over, is going through a period of great industrial and commercial depression, involving lower earnings, large cash absorption, and reduced operations. It would be absurd to hold the management of the Company responsible for this condition of affairs. Yet this time is chosen to make a wholly unwarranted attack, which has unnecessarily depressed the market value of the Company's securities. There is nothing in the present situation differing in principle from similar periods of depression and financial stringency, notably those of 1907 and at the outbreak of the war in 1914. In each of these cases, the metal industry was among the first to revive. There is every reason to believe that a similarly early revival will follow from the present depression; such is the confident belief of the management.

The management of this Company has been faithful to the interests of its shareholders; it has served no other interests; its record has been free from any taint of dishonest or selfish exploitation; it has earned the confidence of stockholders, not only because of its clean record, but by reason of results accomplished. As to the influence of the Messrs. Guggenheim and the value of their services, the outstanding fact is that their association with the Company has been coincident with the great growth and signal success of the corporate enterprise. The undersigned, for themselves and for their fellow directors, desire to record their belief and conviction that the part taken by the Messrs. Guggenheim in the management of the Company and its affairs, has been the greatest single factor contributing to the Company's growth and prosperity, and that it would be most unfortunate if the Company should now be deprived of the benefit of the extraordinary commercial and financial vision and ability they possess.

G. P. Bartholomew,
F. H. Brownell,
L. G. Eakins,
Charles Earl,

John C. Emison,
W. M. Drury,
H. A. Guess,
Frank W. Hills,
William Loeb, Jr.,
W. S. McCornick,
W. E. Merriss,
Willard S. Morse,
Edgar L. Newhouse,
C. A. H. de Smiles,
F. R. Raiff,
E. R. Reets,
John N. Steele,
Evander B. Schley,
Roger W. Straus,
C. W. Whitley,
H. W. York.

Electricity in Coal Mines

During the three decades, 1890-1920, electricity as applied to coal mining made rapid progress until today there remains hardly a task or an operation connected with coal mining that is not directly or indirectly concerned with the use of electricity. From the time the miner takes his electric cap-lamp in the morning until he has completed his task at night he is continually using electricity or electrical equipment. The electric signal tells the hoisting engineer when to start and to stop the hoisting engine. The lights at the several levels and at dangerous crossings throughout the mine are usually electric. The telephone is a part of the equipment necessary underground. Electric shot-firing and electric shot-firing systems are becoming widely used. Electric pumps handle much of the water in the mines. The haulage of coal is done largely by electric-trolley and by storage-battery locomotives and electrically operated hoists. Each year some new electrical device is introduced, says a recent publication of the Bureau of Mines. Electrical equipment for mines, in order to be safe and efficient, must be properly designed, carefully installed, inspected at regular intervals by competent men, and maintained in good working condition. In general, the best way to obtain satisfactory electrical equipment for mine service and to ensure its proper installation, inspection, and maintenance, is for each State to make and enforce fundamental rules and regulations relating to the use of electricity and electrical equipment in and about coal mines. The rapidity with which electrical equipment has entered into the many phases of coal mining has exceeded greatly the advance of regulations governing its use. Even the best electrical mining codes in force need modernizing, and some States have even neglected to mention the use of electricity in their mining laws.

IRON ORE mined in 1920, exclusive of that which contained more than 5.5% of manganese, is estimated at 67,773,000 tons, an increase of 12% as compared with the output in 1919, according to the estimate of the U. S. Geological Survey.

Radio-Activity and Some Practical Applications

By C. W. Davis

*INTRODUCTION. In this survey I shall discuss briefly the following subjects:

1. The discovery of radio-activity and of radium.
2. The disintegration of radio-active elements.
3. The production of radium and mesothorium.
4. The properties of Becquerel rays.
5. The detection and estimation of radium.
6. Radium and mesothorium in self-luminous compounds.
7. The therapeutic application of radium and radium emanation.

THE DISCOVERY OF RADIO-ACTIVITY. In 1895 W. C. Röntgen found that X rays excited fluorescence on screens coated with barium platino-cyanide or calcium tungstate and that these rays fogged photographic plates. The next year H. Becquerel, knowing that X rays caused fluorescent substances to glow, wondered whether the converse were true, that is, would phosphorescent bodies give off invisible penetrative rays. To investigate this, he placed phosphorescent substances on a photographic plate that had been wrapped in two sheets of thick black paper. In about 24 hours, when the plate was developed, a silhouette appeared on that part of the plate which had been directly under a piece of phosphorescent uranium salt. Becquerel attributed this action to rays emitted by uranium and found that these rays had the property of causing a charged electroscope to discharge. A substance emitting these rays, now known as Becquerel rays, is said to be radio-active and to have the property of radio-activity.

In 1898 Professor and Madame Curie found that certain uranium ores were much more radio-active than pure uranium salts. From this they concluded that some element was present in the ore, other than uranium, which caused the radio-activity. They succeeded in extracting radium in the form of the chloride and showed that it was over one million times more active than uranium.

THE DISINTEGRATION OF RADIO-ACTIVE ELEMENTS. According to Rutherford and Soddy, the atom of a radio-active element undergoes spontaneous disintegration, forming a series of radio-active substances quite different from the parent element in chemical properties. This phenomenon within the atom is not affected by any chemical or physical agencies that have yet been applied from without. Thus the uranium atom, uranium having an atomic weight of 238, expels an alpha ray with the formation of a new element, uranium X₁, the latter hav-

ing an atomic weight of 234. The difference of four in the atomic weights of the two elements is due to the loss of a helium atom, helium atoms consisting of alpha particles, each of the latter being composed of four positive and two negative units of electricity. Uranium X₁ emits a beta ray and forms uranium X₂, which in turn breaks down, a series of elements being formed by such processes.

The half-value period or half-period of these elements (by that is understood the time required for one-half the original amount of any radio element to disappear) is very different, ranging from about five billion years in the case of uranium to the fractional part of a second in the case of radium C₁. In spite of the slow rate of disintegration of some of the radio elements, old unaltered minerals have reached equilibrium, that is, the radio elements have a fixed ratio with one another. This fact makes possible the usual case in which one element can be used for the determination of another, as will be shown later.

Just as uranium is the parent of a series of radio-active elements, thorium and actinium each act in a like capacity for a different series of radio-active elements.

THE PRODUCTION OF RADIUM AND MESOTHORIUM. Salts of radium, in the uranium series, and of mesothorium, in the thorium series, are now produced on a commercial scale. Radium in the form of chloride or bromide is obtained from uranium ores by chemical processes that differ in their earlier stages. In most cases the final purification or concentration depends upon fractional crystallization of mixed chlorides or bromides of radium and barium. Barium, having much the same properties as radium, is always found with it at the crystallization stage. Since about two tons of ore (the quantity, of course, varying with the grade of ore used) must be treated to obtain a salt containing 10 milligrammes of radium element (that is, about one three-thousandth of an ounce), the care that must be used in such a process may be appreciated. When the demand for radio-active material for the preparation of the self-luminous compounds used on instrument dials became considerable, a process was evolved in which mesothorium was recovered as a by-product when monazite sand was treated to recover thorium and cerium for use in the manufacture of gas-mantles.

THE PROPERTIES OF BECQUEREL RAYS. A statement of the properties of the primary rays emitted by radio-active substances, that is, the alpha, beta, and gamma rays, will indicate what practical use can be made of them.

Alpha rays are positively charged particles projected at

*Read before the University of Nevada Chapter of the American Association of Engineers, November 3, 1920, at Reno, Nevada, and published by permission of the Director of the U. S. Bureau of Mines.

about one-fiftieth the velocity of light, the velocity and range depending upon the source. Helium atoms have been said to be identical with alpha particles, each of the latter, as previously explained, consisting of four positive and two negative units of electricity. (Helium, as will be remembered, is one of the rare inert gases, traces of which are found in the atmosphere and which has been discovered recently in considerable quantities in some natural gases, and is used to fill balloons when a non-explosive gas is required.) The high velocity and appreciable mass of the alpha particles give them an enormous kinetic energy, which, when the particles are stopped, produces heat, one gramme of radium supplying 134 calories of heat per hour, 124 calories of which are due to the alpha rays. This heat is equivalent to that obtained by burning 400,000 grammes of carbon. H. H. Barker, in a paper read before the Teknik Club of Denver, used an interesting illustration to show the enormous energy content of radium. He said, "One ounce of radium in its complete transformation to the end-products will give off enough energy to lift five million tons through a distance of 30 ft. In other words, one ounce of radium will give off enough energy to lift 100 of the largest battleships afloat entirely out of the water". This does not mean that the energy could be used practically, for even if the cost were not prohibitive, the slow rate at which this energy is emitted cannot be influenced. Consequently, the available energy at any time is comparatively insignificant. The penetrating power of the alpha ray, however, is exceedingly small, being absorbed by a sheet of writing paper, a piece of thin glass, or even coatings of varnish. The maximum range of the alpha rays in air at standard pressure and ordinary temperature is about seven centimetres, the air being ionized by the passage of the particles and becoming a conductor. For this reason a charged electroscope is discharged in the presence of substances giving off these rays. The alpha rays affect photographic plates and also cause phosphorescent substances, such as barium platino-cyanide, calcium tungstate, zinc sulphide, willemite, etc., to glow in the absence of light. The alpha rays are deflected in a powerful electric or magnetic field.

Beta rays consist of negatively charged corpuscles or electrons expelled at velocities approaching that of light. Their small mass, about one seventeen-hundredth that of the hydrogen atom, and high velocity produce a penetrating power one hundred times greater than that of the alpha rays, thin glass having very little effect on them and two or three millimetres of lead being required for their complete absorption. The ionization effect of the beta rays is only about one-hundredth that of the alpha rays, but their deflection by an electric or magnetic field is greater than, and in an opposite direction to, that in the case of the alpha rays. Beta rays are less effective in producing phosphorescence in minerals than are alpha rays.

Gamma rays, unlike the alpha and beta rays, are not corpuscular in nature, but, like light rays or X rays, consist of electro-magnetic disturbances. The wave-length

of the gamma ray is much less than that of the X ray and the penetrating power, being from ten to one hundred times greater than that of the beta ray, is also much greater than that of any X rays, penetrating the human body or passing through a foot of iron.

The ionizing effect is only about one ten-thousandth that of the alpha rays and the power of producing phosphorescence in minerals is much less than that of the alpha or beta rays. The gamma rays are not deflected by a magnetic field.

THE DETECTION AND ESTIMATION OF RADIUM. Radium ores usually are purchased on their uranium content, that is, the ore is analyzed for uranium, this value being then divided by a constant to give the quantity of radium in the ore. This is possible, as was stated before, because radium and uranium in an ore have a constant ratio, which has been found to be about 3.33 times 10^{-7} . This ratio is always found to hold when large samples are taken. Small samples often show abnormal ratios, probably due to transposition of radium within the ore deposit. Although this indirect method is usually employed for the estimation of radium in ores, the radio-active property of the radio elements is always used when an exact knowledge of the radium content in a substance is desired. A radio-active method is also used for the detection or rough estimation of radium in ores.

The spectroscope has detected very small quantities of an element, the neon in one-twentieth of a cubic centimetre of air having been identified. Since only one one-hundred-thousandth part of the air consists of neon, then the quantity of neon detected would occupy only one two-millionth of a cubic centimetre at standard pressure and temperature. The detection of alpha rays, however, has been shown to be over one million million times more sensitive than this spectroscopic result.

The electroscope as used for the detection and approximate estimation of radio-active material in ores consists essentially of one chamber in which an aluminum-foil leaf is suspended in such a way as to be entirely insulated from the chamber but connected to a conductor suspended in a second chamber directly below the first, the conductor being insulated from its chamber. The lower chamber has a hinged door for the introduction of samples. The upper chamber is equipped with wire, insulated from it, which may be brought in contact with the leaf system and through which a charge may be introduced to the leaf with a rubbed ebonite rod. The upper chamber is also equipped with a telescope containing a graduated scale by means of which the movement of the leaf can be observed. The leaf system is protected from outside influences by means of a wire net at points that are left open for the introduction of light, etc.

The rate of fall of the charged leaf, in divisions per second, with no radio-active material in the ionization chamber, is called the natural leak. This should be very low for satisfactory results. The ore to be examined should be ground to a coarse sand and spread evenly over a definite area of a container, which is then placed in the ionization chamber of the electroscope. The rate of fall

of the leaf is then noted, and if the leaf moves faster than the natural leak of the instrument, the presence of radio-active material is indicated. If an approximate measure of the uranium content of the ore is desired, an analyzed sample of ore similar to the one being tested is ground to the same fineness as the unknown, spread over the same area, placed in the ionization chamber, and the rate of fall of the leaf noted. The natural leak is subtracted from the observed rates of fall of the two samples. The corrected rates of fall are to each other as their uranium content; one being known, the other is easily determined. Numerous precautions must be observed to ensure trustworthy results. The illumination must be constant. The atmosphere must be reasonably dry. The readings should be taken over the same points on the scale. The physical condition of the samples should be nearly identical. Although this method, known as the alpha-ray method, is not exact, it is useful in the detection of radio-active materials, especially in the field.

As explained before, although the gamma rays have a comparatively low ionizing power, they are not affected appreciably by a sheet of metal that completely absorbs the alpha and beta rays. This forms the basis for the gamma-ray measurement of radium, which is the most accurate method for determining radium in salts containing over 0.1 milligramme of radium. It compares the rate of electroscopic discharge of an unknown salt with that of a standard salt, using identical conditions of measurement, the rate of discharge being proportional to the quantities of radium in the samples.

A special form of electroscope is usually used, but any alpha-ray instrument may be used by placing a lead screen about one-fourth inch thick between the electro-scope and the samples being examined. These samples must be placed in exactly the same position with respect to the electro-scope and should be sealed in glass tubes of the same thickness, otherwise corrections must be applied. The radium salt must have been sealed for a month or more to allow its disintegration products to come into equilibrium with it before comparing it with a standard or the time of sealing must be accurately known so that the percentage rate of accumulation of activity may be determined.

For the exact determination of small quantities of radium, its disintegration product is removed and its quantity determined in an emanation electro-scope. The emanation electro-scope is similar to the alpha-ray instrument, but the lower chamber is made air-tight and fitted with two stop-cocks for the introduction of air or gas. Radium is gradually changing to radium emanation. Radium emanation is the only gaseous member of the radium disintegration series and therefore may be separated readily from the other members.

The emanation is removed from solid substances by heating or fusion while passing air, and from solutions by boiling with the passage of air. The gas is collected in a gas burette of special design over a hot potassium hydroxide solution and then transferred to the emanation chamber of an electro-scope through a micro-drying tube.

This is accomplished by partly evacuating the emanation chamber, attaching a tube from the gas burette to one of the stop-cocks and opening the stop-cock. The sample previous to the removal of its emanation must have been sealed up for at least a month or else the results must be corrected to conform to the equilibrium conditions existing at the time of treatment. The electro-scope must be standardized, that is, the emanation from a known quantity of radium is placed in the emanation chamber and, after standing three hours to get the maximum ionization effect, the rate of discharge of the leaf is observed. The same procedure, namely, getting the rate of discharge, is carried out on the unknown sample, and after correcting for the natural leak in both cases the rates of discharge are proportional to the radium content of the two samples.

RADIUM AND MESOTHORIUM IN SELF-LUMINOUS COMPOUNDS. Phosphorescence is generally understood as the property of a body to glow in the dark after having been exposed to the action of light. Certain phosphorescent substances are activated by Becquerel rays, the alpha rays being much more effective than the beta rays, which in turn are more effective than the gamma rays. The light effect when caused by radio-active rays has been shown to consist of an infinite number of individual flashes of light and is supposed to be the result of the collision of radio particles with particles of the phosphorescent substances. Various theories have been advanced to account for this action, but, in general, the opinion is held that the phenomenon is part physical and part chemical in nature. Other rays produce a similar effect, but substances that are most highly luminous when activated by one kind of ray may not be nearly so luminous when activated by other rays, that is, each substance has a class of radiation through which its maximum luminosity is attained. For example, two phosphorescent compounds may be exposed to the light, and, when seen in the dark, *A* is more luminous than *B*, but when the same substances are exposed to Becquerel rays, *B* may be the more luminous. After a phosphorescent substance has been exposed to alpha rays for a considerable period, the phosphorescence is gradually destroyed. It is said to 'decay'. The rate at which this decay progresses depends on the intensity of the bombardment by the alpha rays. It has been said that in the presence of large quantities of radium the phosphorescence from phosphorescent zinc sulphide would disappear in 12 hours. As usually prepared the phosphorescence of phosphorescent zinc sulphide will last for several years before becoming too dim for further use.

Barium platino-cyanide under the action of alpha rays turns a brownish color and loses its phosphorescence. The original color and also the phosphorescence may be restored by heating. Phosphorescent sulphides of barium, calcium, and strontium when destroyed by the action of alpha rays may be restored to their original condition by passing a current of hydrogen over them, but not by heating alone. Phosphorescent zinc sulphide, however, its phosphorescence destroyed by alpha-ray bombard-

ment has only been regenerated by preparing the material anew.

Although the preparation of phosphorescent zinc sulphide for use in the manufacture of self-luminous compounds is a trade secret, each producer carefully guarding his formula and method of procedure, the general features of the process seem to be as follows: A zinc salt is freed from impurities that interfere with the formation of the phosphorescence, such as iron, nickel, tin, etc., and the zinc is then precipitated from solution as a sulphide, a small quantity of some other element is introduced either before the precipitation takes place or later, and the sulphide is dried, ground to pass a 200-mesh screen, placed in a closed crucible, and heated to a bright red for a definite length of time. The quantity of the addition substance is so small, in the finished product, that its identification is difficult. For this reason the secret of the composition of the substance is reasonably safe. Although the amount of this substance is small, it has a very marked influence on the color and intensity of the luminescence produced when the material is acted on by radio-active rays. The finished phosphorescent zinc sulphide is mixed with a very small quantity of a radium salt and is ready for use. Although the quantity of radium employed depends somewhat on the use that is to be made of the compound, a very bright material of comparatively short life having more radium than one not so luminous but of longer life, the limits are about 0.1 to 0.25 mg. per gramme of phosphorescent zinc sulphide. The luminous compound may be mixed with water-white varnish and painted on or enclosed in glass and used for illuminated instrument dials, light-pulls, keyholes, etc. Although radium salts sell for more than \$100,000 per gramme of radium element contained, the quantity of radium required for enough material to illuminate the dial of a watch has been estimated to cost 15 cents.

The use for radium in luminous compounds has been discouraged and for good cause. The radium so used is lost, and since the known deposits of radium ores are being rapidly exhausted, the future supply of radium for use in therapy should be gravely considered and no waste permitted at the present time. Although the half-period of mesothorium is short when compared to that of radium, the rate of decay of phosphorescent zinc sulphide is such that mesothorium can well replace radium in the preparation of self-luminous compounds.

THE THERAPEUTIC APPLICATION OF RADIUM AND ITS EMANATIONS. The use of radium in therapy depends on the fact that intense rays from radio-active substances have the power of destroying living cells; not only that, but there is a differential action in that diseased cells are more readily attacked than healthy ones. Healthy cells, however, are affected if exposed for some time to an intense radio-active source, an exposure of a few minutes causing a severe burn in case of a salt with high radium content. The burn is similar to an ordinary burn except that the results do not appear so rapidly, a blister often developing a day or so after the exposure was made. The alpha rays, having such a small penetration, are of no

therapeutic value, but the beta and gamma rays, especially the latter, find their greatest value in this field. Beta and gamma rays are not emitted by either radium or its next disintegration product, radium emanation, but radium *B* and radium *C* furnish them. Radium *B* and radium *C*, however, have such short half-periods that it is usual to employ either radium salts or radium emanation in which the disintegration products radium *A*, *B*, and *C*, have come to their maximum activity. In the case of radium salts they may be sealed up in glass tubes and used in that condition. Radium emanation is as a rule removed from a solution in which the emanation has been allowed to accumulate. The emanation, having a half-period of 3.35 days, must, of course, be used while it contains the desired activity. The maximum activity is reached in three or four hours after its collection.

In spite of its short half-period radium emanation has several advantages over radium salts in direct application. The emanation is comparatively inexpensive, so that the loss of a tube of it is of no great moment. Radium, on the other hand, is not only very valuable but is not always readily replaced. Emanation can be readily concentrated by removing extraneous gases by chemical means or by condensing it in liquid air and placing it in a container the size of a sewing-needle; or it may be diluted and allowed to fill any form of applicator.

The application of radium or radium emanation in therapy not only requires a specialist but also demands a constant access to considerable quantities of radium, 500 milligrammes not being considered a surplus. A number of factors determine the results obtained by the action of the radio-active rays: the intensity and time of exposure, distribution, distance of the source from the healthy tissues as well as from the lesion, and the nature of the screen between the radio-active material and the patient. All these are of importance.

The use of radio-activity has effected numerous remarkable cures in a large variety of diseases, such as ulcers, malignant skin diseases, tumors, various forms of cancer, and the success to be expected in this direction is directly proportional to the development of a knowledge of technique.

THE quantity and value of important mineral products of the Philippine Islands in 1919 is shown below. It will be observed that gold is by far the most important product and except for silver the only important metal.

Product	Quantity	Value, *pesos
Metallic:		
Iron, metric tons	67	34,964
Iron ore, metric tons	18,598	92,996
Silver, fine grammes	261,558	18,828
Gold, fine grammes	1,970,651	2,619,449
Non-metallic:		
Asbestos, metric tons	375	37,500
Bituminous rock, metric tons . .	1,400	21,000
Cement, barrels	10,396	124,752
Coal, metric tons	32,892	822,300
Lime, metric tons	20,000	534,000

*Normally equal to 50c. in U. S. currency.

A Method of Recording Geology in Development Work

By C. Erb Wuensch

My observations have revealed an almost universal neglect on the part of operators of small mines to properly record geologic data that are obtained in the course of mine development. Even some of the larger companies, who keep accurate geological maps, may find some of the following suggestions of value. In the development of mines the operator, who is in charge of the work, often fails to realize that some day his successor might profit by a few properly preserved specimens of ore and country rock as well as some notes relative to the ideas he had in mind in conducting his development. Moreover, the effort required in recording this information may prove of value to himself; it will stimulate accuracy, observation, and imagination.

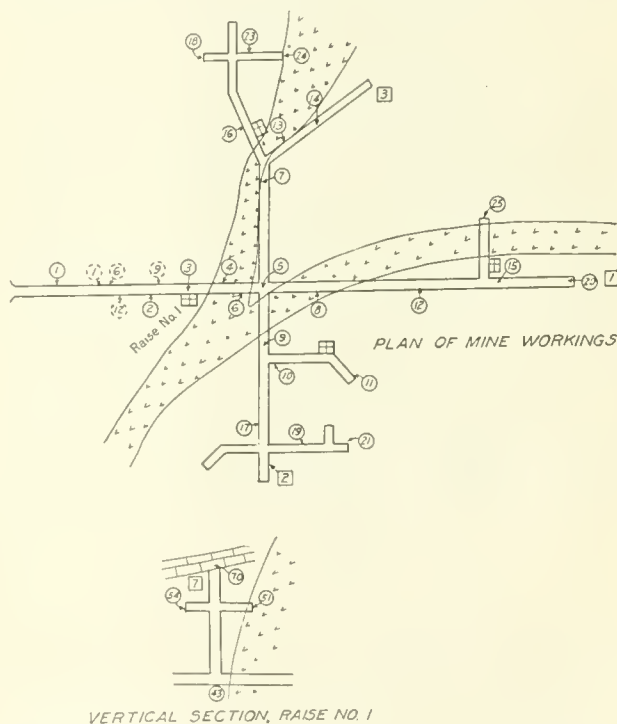
From these general remarks one can readily outline in his mind the method of procedure to accomplish the purposes suggested. It may be of interest for me to give a few suggestions as to some of the methods that I have found effective. In the map room build two sets of shelves or cabinets. One will be used for permanently preserving the various type specimens; this will be the 'permanent cabinet'. The other will be used as a receptacle for the specimens that are collected during the progress of the various workings—the 'temporary cabinet'. It is well to cultivate the habit of carefully collecting specimens, and to compare them underground with the material in the same drift and thus obviate the necessity of gathering innumerable specimens that will serve no useful purpose. However, it is good practice to col-

Battle Mountain. The Roosevelt tunnel lateral connects with the Portland shaft at 2131 ft., so that the new discovery is 319 ft. below the tunnel-level and at an elevation of 7794 ft. No assays have been made public, but miners assert the ore will equal in value the rich ore mined at the 23rd level. Arrangements are in progress to resume operations at the main shaft of the Elkhart Consolidated Mining & Milling Co. on Raven hill. No work has been done on company account for more than two years.

DENVER.—The State Industrial Commission has formally notified officials of 47 metal-mining companies in Colorado, of a hearing scheduled for February 15, to investigate the proposed reduction in wages announced as effective March 1. No serious protest to the 50c cut is anticipated, but all parties concerned will be given the opportunity to be heard. Legislative investigation of the State School of Mines was favored by the House Representatives by a vote of 53 to 7.

KOKOMO.—Machinery will be installed as soon as railroad connections are made and machinery is delivered for the Uthoff tunnel. The tunnel is now being cleaned and re-timbered and enlarged. The Michigan adit was

that one finds a rock or mineral specimen in the type collection which he wishes to compare with another whose position he does not know. He, therefore, has merely to refer to the list of rocks and from the description given he can quickly ascertain its position on the map. Some method of dividing the mine into blocks and referring the numbers to some known origin similar to the co-ordinates X, Y, Z, as used in solid and analytical geometry, might be used to advantage.† The other rocks, from which these type specimens were selected, are then discarded. The pencil numbers corresponding to the rejected specimens are erased from the map and the metal tags placed back with the 'active' tags. It is a good idea to have



about 100 metal tags stamped with numbers from one to one hundred. In this way errors in numbering, by duplication, of the temporary rock specimens is obviated.

The permanent type-specimens are numbered consecutively, in the order in which they are placed in the cabinet, regardless of their location. These are numbered with India ink, written on a small patch of white lead, just as specimens are labeled in museums. This makes a reliable means of identification. It is surprising how few specimens it is necessary to collect in order to have a permanent record of the characteristic rocks from a mine. In long drifts, frequently, but one or two specimens are required. Or, if a number of cross-cuts, for instance, all

†'Scientific Numbering of Mine Workings', by C. Erb Wuensch, 'Engineering & Mining Journal', Dec. 2, 1916, page 977.

cut the same formation, it will not be necessary to collect specimens from each individual cross-cut. A number can be given, in reference to each cross-cut that will correspond to the one taken from one of the other cross-cuts.

The numbers in the squares are those which will be used to refer to the note-book in which brief mention is made as to the idea that the operator had in mind at that point in his development. For instance, take the point in square No. 1, at the end of the main tunnel (see sketch). The memorandum referring to this number might mention that at this point drifting was discontinued temporarily on account of the necessity of curtailing the development expense, and that in the future it is intended to advance this drift and cross-cut the dike to the north at regular intervals. Likewise at the point in square No. 7, shown in the vertical section of raise No. 1, the operator would probably say that limestone was struck on top of the raise and that it is inadvisable to extend this raise, as no ore had been found above this horizon. These brief memoranda will enable the later operator to know why a particular piece of work was done, or why further development work was not done.

Anyone who has done geologic mapping realizes how difficult it is to indicate graphically some of the subtler geologic distinctions, such as variations in degree of silicification, texture of the rock, metamorphism, or mineralization in a formation for which he has used a certain legend. It is, therefore, evident that, by the use of properly recorded specimens, a more accurate interpretation of the geology can be conveyed. By the intelligent use of these specimens, in conjunction with geologic maps, one is able to study more intensively the geology of a mine. For instance, by referring to the geologic map, two portions of a mine may have identical structural features; in one there may be ore, whereas at the other there may be none. Yet by comparing the rock specimens from these two regions it may be possible to see immediately the differences in degree of mineralization.

Another advantage of this system of collecting samples is its use at a large mine where there is liable to be a more or less frequent change in personnel. The newcomers will be able to learn rapidly the geology of the mine. Portions of the mine which now may be inaccessible can also be studied. This is important because later developments may reveal the advisability of further prospecting in such areas.

It might be well to call attention to the fact that a man with practically no geological training can utilize these ideas. Even though he does not know the scientific names of rocks or minerals, he nevertheless can distinguish one from the other by direct comparison and may even coin names to meet his demands. If the mine is subsequently examined by an engineer, the latter can translate the practical man's terminology into technical language as well as make the necessary corrections in mapping and geological interpretation. Still another advantage that might be mentioned is the manner in which it facilitates sending reports to consulting engineers, who make their residence in the larger cities and

pay only periodic visits to the mine. It will make the mine reports more intelligible and valuable to them.

Almost every mine that has been productive is given a thorough geologic study before it is abandoned. Any geologist will appreciate the value of properly preserved rock specimens, especially if properly correlated with the mine workings. Many places which are now inaccessible might have to be re-opened in order to give sufficient knowledge to draw intelligent conclusions. Rock specimens from some of these places frequently might save this expense.

Crude petroleum from different districts may vary greatly in appearance. Samples may differ notably in color. By reflected light, as seen in a pail or other container, oil is commonly green, but it may be any one of several shades of green, or it may be black, brown, or yellow. Most of the petroleum from California, from the Gulf coast of Texas and Louisiana, and from Mexico are black or dark brown. Most of those from Wyoming, Kansas, and Oklahoma are green. Most of those from the Appalachian field are green or yellow. All the more productive oil districts of the United States, however, yield both dark and light oils. The color of petroleum as viewed by transmitted light—that is, as seen in looking through a clear glass container full of oil—may differ as much as it does when viewed by reflected light. It is most commonly some shade of brown, but it may be yellow or green, or, rather exceptionally, it may be coal-black. The color of oil is a rough indication of its value. Oils of the lightest color are generally the most desirable. The typical Pennsylvania oils, which have a higher market value than all others, are amber, light brown, or light green. Dark oils are rarely seen in the Pennsylvania district, and such as are obtained there have a comparatively low value.

The use of radio-activity has effected numerous remarkable cures in a large variety of diseases, such as ulcers, malignant skin diseases, tumors, various forms of cancer, and the success to be expected in this direction is directly proportional to the development of a knowledge of technique.

THE quantity and value of important mineral products of the Philippine Islands in 1919 is shown below. It will be observed that gold is by far the most important product and except for silver the only important metal.

Product	Quantity	Value, pesos
Metallic:		
Iron, metric tons	67	34,964
Iron ore, metric tons	18,598	92,990
Silver, fine grammes	261,558	18,828
Gold, fine grammes	1,970,651	2,619,449
Non-metallic:		
Asbestos, metric tons	375	37,500
Bituminous rock, metric tons	1,400	21,000
Cement, barrels	10,396	124,752
Coal, metric tons	32,592	822,300
Lime, metric tons	20,000	534,000

*Normally equal to 50c. in U. S. currency.

REVIEW OF MINING

FROM OUR OWN CORRESPONDENTS IN THE FIELD

COLORADO

DIVIDEND DECLARED BY GRANITE GOLD COMPANY OF CRIPPLE CREEK.

BLACK HAWK.—The Denver Mining Pool, recently incorporated, has erected a shaft-house and installed a hoist on its properties, comprising three patented claims situated between the Hard Money and Alaska mines in Gilpin county, both old-time producers. A two-compartment shaft is now being sunk to a depth of 150 ft., at which point cross-cutting will be started to cut the known McIntosh, Anna, Belford City, and Atlantic veins, traversing the property. A vein cut at depth of 80 ft. contains lead-silver sulphide ore. The two trial shipments made from the property settled as follows: No. 1, 127 oz. silver, 0.02 oz. gold, and 8% lead; No. 2, 283 oz. silver, 0.08 oz. gold, and 15.5% lead. The Alaska mine, just south, is making heavy shipments of mill and smelting ore to mills in Black Hawk and smelter at Pueblo.

CRIPPLE CREEK.—The Granite Gold Mining Co. will pay stockholders a 3c. dividend, totaling \$52,500, on February 10. With this dividend stockholders will have been paid \$420,000. The last dividend was paid in March 1918. This is the first dividend by a Cripple Creek company this year. High-grade ore has been found at a depth of 2450 ft. in No. 2 shaft of the Portland mine, on Battle Mountain. The Roosevelt tunnel lateral connects with the Portland shaft at 2131 ft., so that the new discovery is 319 ft. below the tunnel-level and at an elevation of 7794 ft. No assays have been made public, but miners assert the ore will equal in value the rich ore mined at the 23rd level. Arrangements are in progress to resume operations at the main shaft of the Elkton Consolidated Mining & Milling Co. on Raven hill. No work has been done on company account for more than two years.

DENVER.—The State Industrial Commission has formally notified officials of 47 metal-mining companies in Colorado, of a hearing scheduled for February 15, to investigate the proposed reduction in wages announced as effective March 1. No serious protest to the 50c. cut is anticipated, but all parties concerned will be given the opportunity to be heard. Legislative investigation of the State School of Mines was favored by the House of Representatives by a vote of 53 to 7.

KOKOMO.—Machinery will be installed as soon as railroad connections are made and machinery is delivered at the Uthoff tunnel. The tunnel is now being cleaned out and re-timbered and enlarged. The Michigan adit will

shortly be connected by a raise of 100 ft. with the old Michigan shaft. It will be used as an ore-chute for ores from the Snowbank and new workings of the Michigan mine. New ore-bins have been constructed. The Michigan is now marketing 1500 tons of ore monthly.

LAKE CITY.—Returns from a consignment of sacked ore, from the Little Chief group, shipped to the Pueblo smelter, show settlement made with the Standard Mines & Development Co., operating under lease and bond, of 55.9 oz. silver per ton. The ore was entered unexpectedly while driving from the discovery vein, opened in the No. 4 tunnel. The mine is in the southern section of the San Juan Triangle. Ore from the surface workings on the discovery vein, with silver at 60c., brought from \$128 to \$1000 per ton. The vein cut by the present workings is believed to be a parallel vein or the main vein with altered dip. Plans have been made for building a mill and for increasing the operating force.

OURAY.—The Mountain Top Mining Co. is sinking its main shaft and is mining good ore while sinking. Electric pumps to handle a heavy flow of water have been ordered. Fifty miners are employed on the property, 42 on company account and 8 by lessees. Silver ore assaying 70 oz. per ton has been opened by lessees on the Spur group above Black Lake. The ore-shoot is 20 in. thick.

MICHIGAN

ALL MINES MARKING TIME.

Houghton.—A little improvement in the copper-metal situation has been noted in the last two weeks in this district. From 60,000 to 75,000 lb. per day has been shipped from the Calumet & Hecla smelters and about 50,000 lb. per day has been going out from the Quincy smelter, most of it to the East for use by manufacturers of brass. No copper at all is being shipped from here to England and but little to Japan and Germany. Japan at present is getting most of its copper from the Western mines. Shipments have been made, however, to Sweden and France, France being the best customer. Calumet & Hecla recently completed an order of 320,000 lb. of lake-copper for France. Shipments, however, are not making much of an inroad in the metal stocks on hand and copper is piling up on the local docks. Prospects for an early 'clean up' are not bright, although there is hope that the anticipated revival in the automobile industry in the spring and the contemplated nation-wide advertising campaign to encourage a wider use of copper will have a favorable effect on the market.

To effect further economy of operation, Isle Royale has closed its No. 6 shaft, which will remain idle until the market improves. This additional curtailment has thrown 70 men out of work. Only three shafts now are in operation, No. 5, 4, and 1, while three shafts, No. 2, 6, and 7, are shut down. No. 4 and 5 are the best shafts, both of which are opened well ahead, with 75 to 77% of the ground available for mining. But little work is being done in No. 1, in which the quality of the 'rock' is not as good as that in No. 4 and 5.

Seneen, which suffered a mishap to its hoist, necessitating a suspension of hoisting for two weeks until the drum was repaired, is back on its regular program of development. The accident to the hoist, which affected only one of the two drums, did not interfere with the concreting of the shaft from the 6th to the 5th level and that work is nearing completion. The cross-cut from the shaft to the vein at the 6th level will be pushed through the lode in the course of a few days and drifting north and south then will be started. In the Gratiot shaft the raise from the 13th level is approaching the elevation of the 11th. This is all the work of this character that will be done in Gratiot, as the management considers it has accomplished its purpose in proving good stoping ground between these levels.

Victoria is one of the small properties of the district that has managed to operate, although with a greatly reduced force. Sixty men are employed, this force being about 25% or normal. Only one shaft, No. 2, is in operation, on one shift. No drifting or sinking is being done and the management is content merely to keep the mine open and its organization together. A little better than 100 tons of 'rock' per day is being hoisted. The present yield, with careful selection and including occasional mass, is averaging about 17 lb. per ton. Victoria probably will show a production of close to 500,000 lb. of copper for the year 1920, this being an estimate. Victoria is well opened ahead, with extensive drifts on all levels. The 'rock' mined is from the Forrest amygdaloid lode.

Areadian Consolidated plans to investigate the ground north of its Areadian and New Baltic shafts next summer. It is reasonably certain that mineralization in that direction exists. Some preliminary work already has been done. From the New Baltic shaft, on the 400-ft. level, a drift put in to the north opened well mineralized ground sufficiently encouraging to warrant further development to the north from both shafts. It is the intention to run drifts from both shafts simultaneously. In the meantime the work of sinking the New Baltic shaft proceeds in the lode.

NEVADA

BORAX MINE NEAR DEATH VALLEY JUNCTION WILL RESUME SHIPMENTS.

VIRGINIA CITY.—The Mexican mill is treating Consolidated Virginia ore at a rate of more than 500 tons weekly and another filter is being added to increase the capacity from the present 80 to 85 tons up to 150, so that

ore from other north-end mines can be handled in addition to an increased tonnage that is expected from the Consolidated Virginia, where new finds on the 1650, 2150, and 2250-ft. levels are providing the greatest tonnage in recent years. The find on the 1650, reported to be a 10-ft. width of \$40 to \$50 ore, was made in the burned area, and the full width of the orebody has not been determined. This level is producing 200 to 250 tons weekly of \$5.50 to \$8.50 ore, and stoping also is being done on the 1950, 2050, 2150, and 2250-ft. levels. A new station has been cut above the 1750-ft. level of the C. & C. shaft and a station at a corresponding depth has been cut in the Union shaft. A drift has been started from the Union shaft and it will be driven to the Sutro tunnel south of the shaft and eventually connection will be made with the C. & C. shaft, the passage forming a new haulage-way that will form a connection between all of the north-end mines and the Union shaft and will make more economical the carrying of ore to the Mexican mill. A Hoar shoveling-machine is being used in the United Comstock tunnel, the first time such a machine has been used in the mines of the Comstock. It is expected that construction of the mill will be started early in the spring, as a spur from the railroad to the mill-site will be finished in March. The increase in the number of men employed at Virginia City and Gold Hill has created a housing shortage for the first time in many years.

JARBIDGE.—The Elko company at Jarbidge recently shipped through Twin Falls, Idaho, \$174,000 worth of gold bullion, the output of the cyanide plant for one month. The Elko is a Guggenheim corporation that owns the Long Hike and other mines. It is the largest producer of gold bullion in Nevada at the present time.

GOLD CIRCLE.—A 4-ft. width of ore assaying \$100 to \$200 in gold and silver, with narrower veinlets included in this 4 ft. that assay as high as \$2000, has been opened on the 750-ft., or bottom, level of the Elko Prince. This ore-shoot was found last summer, but the pumps could not control the flow of water and the workings flooded to the 600. Some of the ore from the new shoot, being treated in the Elko Prince mill, is said to assay \$600.

PIOCHE.—The 200-ton mill being built by the Pioche Mines Co. will be completed in less than six months. Mill tailing of the Prince Consolidated at Bullionville and Dry Valley, estimated at 100,000 tons, is to be treated under an agreement made with E. R. Richards and Maurice Peterson of Salt Lake City. Richards formerly was metallurgist for the Chief Consolidated at Eureka, Utah. The capacity of the old Bullionville mill is to be reduced from 200 to 100 tons to obtain a better extraction. The tailing, which contains an average of 10.6 oz. silver, 5.3% lead, and 0.11 oz. gold, is seven miles distant on the railroad from the mill.

DEATH VALLEY JUNCTION.—It is reported that the Pacific Coast Borax Co., which recently closed the mines situated in Death valley, is to resume work in the near future. The mines were closed because of high freight-rates to the Atlantic coast, and it is said the com-

pany plans to ship by rail to San Pedro, California, and from there to Eastern points by boat. Shipments were made last year at a rate of about 6000 tons monthly and it is pointed out that the company can ship a boatload monthly from San Pedro. Men who have been at the mines in the last few days say the entire crew was not laid off and that a large quantity of borax is piled awaiting shipment. The company has a factory in California that supplies the demand of the far West, and the Eastern factory is at Bayonne, New Jersey.

UTAH

TINTIC STANDARD MILL STARTS OPERATION.

PARK CITY.—While the directors of the Silver King Coalition Mines Co. have not announced definite plans as to re-building the concentrating plant destroyed by fire

company has been making regular shipments. During January, about 90 loads, or approximately 250 tons, of ore were transported by teams from the bins to the railroad. Charles M. Evans, superintendent, reports that some excellent ore has been opened recently.

EUREKA.—The shaft at the North Standard property is nearing the 1100-ft. level, and it is the intention of the management to continue sinking until the 1150-ft. level is reached, according to John Manson, manager. The bottom of the shaft is now in a limestone-quartz, which contains some gold and silver. When the 1150-ft. level is reached, drifting will be started, as geological conditions are such that ore is expected at that depth. An assessment was recently levied on the stock of the Imperial Lead Co., whose property is in the western part of this district. During 1920, the company produced a sub-



VIRGINIA CITY, NEVADA, THE SCENE OF REVIVED ACTIVITY

on January 27, local officials are of the opinion the plant will be re-built. Undoubtedly if a new plant is constructed, it will provide for flotation-treatment, as the tests carried on recently have been satisfactory, although it is not deemed advisable to supplant the wet-concentration method by flotation exclusively.

During the week ending January 29, shipments from this district totaled 2071 tons, of which the Judge allied companies shipped 1054; Silver King Coalition, 497; Ontario, 405; and Naildriver, 115. The Judge smelter shipped 50 tons of premium spelter.

ALTA.—A carload of ore has been shipped by the Wasatch Mines Co. to a Salt Lake Valley smelter, according to J. E. Beveridge, manager. A promising part of the company's holdings is now being explored by a drift along what is considered the Cardiff over-thrust contact. This work is being done about 6000 ft. from the portal. For the last 250 ft., ore has been found in small bunches and in stringers. Owing to the excellent condition of the road in Little Cottonwood canyon, the Columbus Rexall

stantial tonnage of lead ore, and officials state that development will be resumed this spring. At the Utah Zinc Co.'s mine, development work has been carried on during the present winter, and several carloads of lead-zinc and silver-lead ore are awaiting shipment, according to B. F. Fleiner.

Shipments from the mines in this district totaled 172 carloads during the week ending January 29, of which the Tintic Standard shipped 63; Chief Consolidated, 34; Iron King, 16; Eagle & Blue Bell, 15; Dragon, 14; Iron Blossom, 11; Victoria, 7; Grand Central, 3; Centennial-Eureka, 3; Swansea, 2; Gemini, 1; Eureka Mines, 1; Colorado, 1; and Sunbeam, 1.

About three cars of ore per day are being shipped to the new mill of the Tintic Standard Mining Co. Five of the seven roasters are in commission, and aside from a few mechanical adjustments, operations are reported as satisfactory. C. W. Frith, for some time past metallurgist at the Tintic Milling Co.'s plant, has been appointed assistant superintendent of the mill.

BRITISH COLUMBIA

ONE SUIT INVOLVING PREMIER MINE DISMISSED; ANOTHER STARTED.

STEWART.—A tion brought by Maurice W. Bacon against R. K. Neill, one of those interested in the Premier mine, for the recovery of a one-quarter interest in the property has been dismissed by Federal Judge E. H. Rudkins, in the courts at Spokane. The latter in his judgment states that the plaintiff in two cases had influenced witnesses and had lacked good faith in not bringing the suit in 1917 when he first knew of Neill's operations, instead of waiting until the mine had proved of worth. Patrick Daly, of Nelson, B. C., is suing R. K. Neill, R. W. Woods, A. B. Trite, and W. R. Wilson, all of whom are interested in the Premier mine, for a one-fifth interest in the same. He alleges that Neill entered into an agreement with him to finance the development of the property and to give him the share he is asking for. This undertaking, he asserts, was approved by the other defendants when they became partners.

P. S. Jack, who for the past five years has been mining recorder here, has been made business manager for the Algoniean Development Co. A considerable amount of development has been done at the Nabob group, but a good deal of it appears to have been misdirected. An adit was driven a considerable way before it was discovered that it was parallel to the vein. A cross-cut was then run, and a raise put up, but the ventilation was so bad that the work had to be suspended. Another tunnel was then driven, and this has penetrated a 12-ft. vein, showing free gold. Work has been stopped until the spring.

ASHCROFT.—A large quantity of hydraulic placer-mining machinery is being moved from the Bullion and Horsefly mines in the Cariboo district, by R. T. Ward, who recently sold these claims after successfully asserting his title, and that of his associates, in a legal battle with John Hopp, which was carried to the Privy Council, England. The claims are said to have changed hands at a considerable figure and the nature of future operations is such that the long disused equipment is not required.

NELSON.—The Columbia section of the American Institute of Mining Engineers, whose membership is taken from the North-Western States, will hold sessions next summer at Nelson and Trail, the dates to be arranged to coincide with those of the International Mining Convention to be held at Nelson. It is likely that these joint gatherings will take place sometime in June. S. G. Blaylock, general manager for the Canadian Consolidated Mining & Smelting Co., has promised his cordial co-operation in the endeavor to entertain the visitors.

ONTARIO

MINES AT PORCUPINE PLAN TO INCREASE SCALE OF OPERATIONS.

Preparations by the Imperial Oil Co. for the resumption of oil-drilling and prospecting on an extensive scale in the Canadian North-West have been suspended as a

result of the recent suspension by the Government of the regulations for the disposal of petroleum rights. C. O. Stillman, president of the company, said that the action of the Government had come as a complete surprise, and they were unwilling to take any further steps in the way of resuming operations until the Government policy had been announced. This, he added, is still the attitude of more than a score of local syndicates and small Western prospecting companies. The interests involved are of such importance in their relation to the opening up of the North-West that it is not likely that the adoption of a permanent policy in regard to the question will be long delayed.

PORCUPINE.—As abundant labor is now obtainable, the increase in the supply of power in the spring will result in a large increase in gold production. The leading mines are preparing for increased output. The Hollinger, it is expected, will be treating at least 3000 tons per day by early summer. The Dome Mines can handle 1350 tons per day, as compared with 400 tons at present, and the McIntyre is prepared to treat 600 tons in place of something less than 400 tons, which is the limit under existing conditions.

Negotiations looking to an amalgamation of the West Dome and the Dome Lake are well advanced. The merger would be to the advantage of both companies as the Dome Lake veins extend into the West Dome territory, and the Dome Lake shaft could be used economically for the extraction of ore. It is reported that the Keora has cut another rich vein on the lower levels, confirming the indications of diamond-drilling showing high gold content.

KIRKLAND LAKE.—It is officially announced that operations on the Bidgood will be resumed. The capacity of the present mining plant will be doubled. The shaft now down 300 ft. will be sunk further. D. H. Angus, formerly manager of the Tough Oakes, has been appointed manager. Operations have been started on the Kitchener-Kirkland in the Goodfish Lake section of the camp, where a force of 12 men is at work. The big new mill of the Wright-Hargreaves cannot go into operation before spring, as power is not obtainable.

COBALT.—The mines which remain open are working steadily and no further curtailments are anticipated.

The Primo Silver Cobalt Co. has been incorporated for the purpose of taking over and operating the Barber property, which lies in the western part of Coleman township. A small mining plant has been purchased and is being transported to the property. Several veins have been opened in which silver is found; one vein about 18 in. wide contains 5% cobalt. Sinking is to be commenced, with effort directed toward developing silver ore from which cobalt can also be obtained as a by-product.

BOSTON CREEK.—At the Miller Independence the cross-cut north from the 500-ft. level of the main shaft has reached a length of 530 ft., and has penetrated numerous veins, the most important being the one already showing in the face. The cross-cut will be continued to the northern boundary about 150 ft. further to reach what is believed to be the chief area of mineralization.



COPPER PRODUCTION

The following list shows the output of the leading copper producing companies during 1920 as compared with 1918. The figures are pounds. The same companies in 1919 produced a total of 1,045,229,733 pounds.

Company	1920	1918
Ahmeek	20,489,338	24,851,235
Allouez	2,499,239	7,071,218
Anaconda	160,450,000	293,603,726
Calumet & Arizona.....	40,866,000	51,357,154
Calumet & Hecla.....	57,618,683	67,968,357
Centennial	561,284	2,492,857
Cerro de Pasco.....	52,810,000	71,906,000
Chino	45,705,490	76,635,641
East Butte	18,773,200	25,091,000
Granby	27,101,035	38,808,515
Greene Cananea	43,458,000	53,349,515
Inspiration	81,250,000	98,540,041
Isle Royale	10,621,201	15,442,508
Mohawk	10,269,824	10,781,041
Miami	55,092,288	58,407,563
Nevada Con.	48,299,256	76,607,062
New Cornelia	40,818,456	46,950,139
North Butte	16,597,914	20,680,695
Old Dominion	29,961,700	33,378,000
Osceola	7,464,933	15,919,647
Phelps Dodge	95,062,000	212,383,000
Ray	48,397,935	83,599,160
Shattuck Arizona	2,374,148	9,081,959
Superior	319,459	1,676,446
United Verde Ex.....	42,100,470	23,229,335
Utah	102,573,942	188,092,405
White Pine	1,852,787	3,273,680
Wolverine	3,299,286	4,242,787
Total	1,066,687,868	1,625,420,814

PETROLEUM PRODUCERS PROTEST MEXICAN PLAN FOR TAXATION

Formal objections to the Government's projected law providing for the payment of taxes on oil were presented to Adolfo de la Huerta, secretary of the treasury, on February 2 by a committee representing the Association of Producers of Petroleum in Mexico. Assertion was made by members of the committee that it was the most energetic protest as yet made to the Government by the association. The memorandum contained charges of "subterfuge" in the designation of the act, and a declaration "that companies which export petroleum are subject to maneuvers which can be arbitrary on the part of officials or the employees of the secretary of finance". It is alleged the projected legislation would levy exorbitant taxes wholly out of proportion to the value of the product. Declaration by the Government that the proposed law would provide for a production tax, was denied by the protest, which asserted the only portion of oil production affected by the tax would be that which includes crude petroleum and its products exported from Mexico. "Exorbitant increases in the tax to be levied on petroleum are provided for in the proposed law," said the memorandum. "For instance, Panuco crude petroleum would bear

a tax of 41% of its total value, or four out of every ten barrels; Tuxpam crude would be taxed 28%, or nearly three barrels out of ten, and fuel-oil would bear 31% tax, or one barrel out of every three produced. Such a tax would ruin any business."

It was stated semi-officially that administration officials had combined to push the projected law during the coming session of the Mexican congress, and it was declared that President Obregon would urge a specific provision in the law stating that article 27 of the constitution, which would nationalize oil deposits would not be retroactive. The President has on several occasions declared this was his view of article 27.

ZINC-OXIDE PLANT OF THE AMERICAN ZINC, LEAD & SMELTING CO.

At its new plant erected in Columbus, Ohio, for the production of lead-free zinc-oxide, the American Zinc, Lead & Smelting Co. is getting some highly satisfactory results. This manufacturing unit was completed last fall at a cost of \$750,000. It has a rated annual capacity of 7500 tons of zinc oxide, the ingredient so necessary in the construction of automobile tires. At present the plant is producing at the rate of 3750 tons annually, or 50% of capacity. It was unfortunate from the trade standpoint that American Zinc company's new plant should come into production at just the beginning of the depression in the tire industry, but though present output of 50% capacity naturally cannot permit of much profit, the officials are gratified at the excellent results being obtained from all departments. Having its own supply of high-grade zinc ore at its Mascot mine in Tennessee, the American Zinc company is expecting to get a substantial amount of business when the tire companies resume greater production. With production at or near the new plant's capacity, the American Zinc company expects earnings from the zinc-oxide business alone that will provide the \$6 dividend on the 80,540 shares of preferred stock held by the public.

ALASKA

Hyder.—The steamship 'Albert' is due with 240 tons of machinery for the Premier mine. A large part of the shipment is cyanide for use in the mill now nearing completion. The wharf at Hyder is not sufficiently large to accommodate the incoming freight and outgoing ore and will be enlarged. Approximately 400 tons of ore valued at \$500 per ton will be shipped on the return trip of the 'Albert'.

CALIFORNIA

Amador County.—The supply of labor in the Sutter Creek and other districts is adequate and operations on a larger scale have been commenced at several of the mines. The Central Eureka stamp-mill is now running at full capacity of 40 stamps instead of 20 stamps, as formerly.

Work is progressing at the Fremont Consolidated and Bunker Hill, two well known Amador producers recently rehabilitated after long idleness. Improved labor efficiency and lower prices of materials used in mining are proving advantageous.

Nevada County.—The United American Mining Co. has recently taken over the Ironclad mine in the Rough and Ready

district. H. M. Black has employed a number of miners and will increase his force soon. The Ironclad lode was discovered in 1878 and at that time several shipments of ore valued at \$17.50 per ton were shipped to the old Southern mill at Grass Valley.

Plumas County.—With the mill treating ore from the Engels and Superior mines, the Engels Copper Co. continues to produce at a good rate despite the many unfavorable conditions affecting the copper industry. Considerable gold and silver in Engels ores materially aid operations, as the profits derived from the precious metals compensate for lower copper prices. —The Mason Valley Mines & Smelter Co. will start work at its holdings on the Plumas copper 'belt' soon, according to reports. —Development work only is being done at the Walker copper mine.

San Bernardino County.—W. H. Voyles and associates, of Salt Lake City, are prospecting a rich vein of gold-silver-copper ore situated just over the mountain from the Ivanpah mine, from which several million dollars worth of rich silver ore has been mined. The new mine is called the Sunshine Silver. A shaft has been started, at the bottom of which is a 15-in. vein assaying 375 ounces of silver and containing in addition 29% copper. The nearest railroad point is Cima on the Salt Lake route, and economical transportation will be one of the problems to be solved.

Sierra County.—W. W. Casserly, superintendent of the Kate Hardy mine at Forest, will install an air-compressor of capacity sufficient to operate 20 drills and will begin work on the erection of a 10-stamp mill as soon as weather permits. —At the Mugwump gravel mine Dennis Coughlan is increasing the force of miners, following a 'strike' of particularly rich gravel. —George F. Stone is developing and blocking out ore on the North Fork property. —At the Diadem quartz mine an electric hoist and sinking-pump, direct-connected to an electric motor, a hoisting cable, and a mine-skip have been received in anticipation of active work in the spring. The mine was recently bonded and the lessees have placed J. E. Osslin in charge of operations.

Sonoma County.—Charles A. Peary of Healdsburg has patented a process for recovering fine gold and platinum from 'black sand'. The device is briefly described by a correspondent as follows: It consists of a bucket, containing a hopper which sets in the head, an inverted cone set some inches above the bottom of the bucket, and a water-pipe which projects through the bottom and supports the cone by means of brackets. Water is forced through the pipe and inside the cone and upward through the hopper. The sand or fine crushed ore is fed into the hopper. The water being deflected downward by the cone and then finding its way to the top causes agitation of the mass in the bucket and the waste or residue flows over the edges of the bucket. The heavier material such as fine gold, sulphides, black sand, or platinum will settle to the bottom and concentrate, the lighter material running off. The feeding is a continuous process and may be continued until such time as it is necessary to make a cleanup. In a plant where the sulphides or metal may tend to clog the free flow of water from under the cone, buckets may be arranged in batteries and some be used while others are being cleaned. It is impossible to clog the flow of the machine as long as the concentrates are not allowed to accumulate to too great an extent.

COLORADO

Grand Junction.—The Western Shale Oil Co., after a year of experimentation, has started operating a 50-ton unit at its plant here. The Gallop process is used, the latest designed furnace having effected a saving of 40% in fuel over that consumed by the earlier type. It is expected to mine by an open-pit method for \$1.25 per ton, to grind the shale in an American pulverizer for 30c. per ton, and to retort for 30c. per ton, making a total cost of \$1.85. The oil will be

refined at the plant of the Apex Refining Co., of Denver, where, after removing gasoline and perhaps kerosene, an excellent oil for use in flotation plants will remain.

Idaho Springs. The Gem company is making shipments of 50 tons daily to the smelter, while a lower-grade product is being sent to the Newton mill now operating steadily on three shifts. The drift has been advanced 400 ft. —Returns from a recent shipment of ore from the Dunkirk mine, made by the Mitchell lessees, netted \$241 per ton. A second lot of ore not quite so high in grade is ready for shipment.

Leadville.—An agreement has been reached between the Leadville Mine Development Co. and the Leadville Land & Water Co., whereby the latter will allow the mining company the privilege of dumping on its land. The adit will be commenced at once.

IDAHO

Boise.—The annual meeting of the Idaho Mining Association was held here on February 11 and 12. Among the subjects discussed were the following: the tariff question, the Kitchin revenue act, the alleged injustice done the locator of mining claims by the 640-acre enlarged homestead act, and the proposed change in the date for completing annual assessment work. D. H. Ferry, manager for the Yukon Gold Co., and Walter C. Clark, of the Bunker Hill & Sullivan company, gave illustrated lectures.

Coeur d'Alene.—The Big Creek district known as a silver-bearing belt is attracting unusual attention owing to large amount of development work under way and the erection of the second concentrator on the creek. Steady shipments are going to the smelter from the Big Creek Mining Co. Equipment for the 50-ton concentrator for the Sunshine Mining Co., operating the Yankee Boy and Yankee Girl properties, is on the ground and it is planned to have the mill in operation early in the spring. —The Sterling Silver Mountain company is developing a group of claims adjoining the Yankee Boy. A blind vein was cross-cut near the 500-ft. station, showing a width of eight feet containing gray copper. A drift will be started on this vein and at the same time the main cross-cut will be continued toward its objective, which will be reached in 300 feet.

The new freight-rates from Coeur d'Alene points to the Northport and East Helena smelters effect a big saving on the higher-grade ores, and under the least favorable conditions are 50c. per ton lower than the old rates, while the greatest saving is \$5.37½. The ores chiefly affected are the Hercules and Tamarack & Custer going to Northport, and the company ore and that of the lessees in the Morning mine of the Federal company, which goes to East Helena. The new rates are \$3 per ton for \$30 ore and an increase of 25c. for each \$10 increase in value of the ore up to \$4.75 for \$100 ore. Above \$100 there is a flat charge of \$5. The old rates were \$4.25 per ton for ore under \$60, \$6.25 for ore between \$60 and \$65, and between \$65 and \$100, 9.37½.

In the Pine Creek district the development work is under way on the property now owned by the Jim Blaine Silver syndicate. The company is developing a mineralized belt by means of a long cross-cut tunnel, designed to give approximately 700 ft. vertical depth on three veins, namely, the Bristol, Midnight, and Constitution. The Jim Blaine company has a good silver-lead ore in its upper workings. The company recently consolidated three well-known groups, the Bristol, Jim Blaine, and Chesapeake, comprising 500 acres in the heart of the mineralized zone of the Pine Creek belt. —Drifting on the 400-ft. level of the Chicago-Boston property has been extended for 40 ft. east on the vein with no ore yet. The condition of the vein remains the same as it was a week ago when it was first crossed by the drift from the new 400-ft. level of the shaft. Stringers of high-grade ore have been present, but nothing like a good body of ore has yet been found.

MISSOURI

Joplin.—Walter Carter, while drilling a well on his farm near Cartersville, found a deposit of lead ore at a depth of 90 ft. The deposit at that point is 20 ft. thick. A shaft is being sunk to mine the ore and prospecting in the vicinity is being done by numerous land-owners.—A new company, composed of Pittsburgh capitalists, has purchased the Morning Star, Capps, Carney, Philadelphia, and Red Cloud mines in the vicinity of Rush, Arkansas. They expect to be ready to commence operations when the prices of metals improve.

MONTANA

Great Falls.—The zinc refinery of the Anaconda Copper Co. was shut-down February 1. The smelter, which handles zinc residue, will continue to operate for 30 days. About 1500 men are employed in the two departments. The copper-wire mill, the electrolytic copper refinery, and the copper furnace refinery, in which about 600 men are employed, will continue operation.

Helena.—It is reported that the Barnes-King Development Co., which recently acquired the Black Hawk claim in the Marysville district, has uncovered the Penobscot vein.—Work has been started on the construction of the new mill of the Alta Consolidated Co. at Corbin. The mill will first re-treat the tailings dump from former operations. S. L. Bright, of Chicago, an official of the Alta company, has been at the property.

Neihart.—Regular shipments are being made from a number of mines in the district. Ten cars were shipped from the Hartley property during January. The low price of lead is materially decreasing the profit on the ore.—Liscomb & Parmeter, lessees at the Flohart property, are mining ore regularly from their block of ground situated above No. 2 tunnel.

Townsend.—A vein of good galena ore from 2 to 5 ft. wide has been penetrated by the Iron Mask adit. Butte men during the past two years have spent more than \$200,000 driving this adit.

White Sulphur Springs.—The first carload from the Willow Creek mine has been shipped. The railroad company has promised to build a sidetrack to facilitate loading ore.

NEVADA

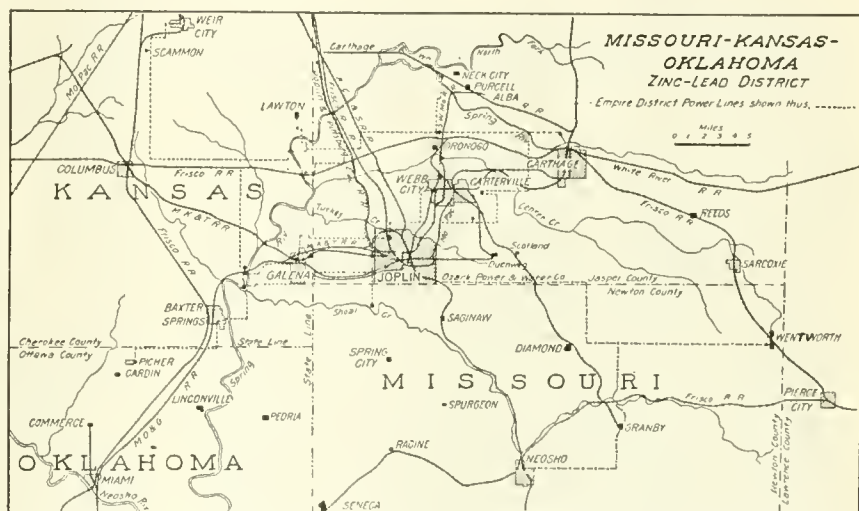
Eureka County.—The Eureka-Holly mine is producing more than ordinarily high-grade ore from the 500-ft. level. The drift on the 600-ft. level has 80 ft. more to run to get under the same ore-shoot. On the 400-ft. level a large quantity of ore is being broken, ready for treatment in the mill, as soon as the latter is ready to operate. It is estimated that there is ore worth \$700,000, which may be profitably treated in the mill.—The water in the Locan shaft, on Ruby hill, was drained to within 18 in. of the bottom, admitting of the removal of debris that had accumulated. Edward Holter, of New York, president of the Ruby Hill Development Co., and Howard D. Smith, a director, have been visiting the mine. Previous to their inspection of the Richmond-Eureka mine they were two weeks in San Francisco. Since their departure, a report has gained circulation that operations in the Locan shaft are suspended indefinitely, but no information can be had from anyone in authority. There is considerable surmise as to the aims of the Ruby Hill Development Co. It has, it is said, until next December to sink the additional 500 ft. of the Locan shaft and take over 59/100 of the holding stock. There seems to be no doubt on the part of geologists that the lower wedge

of limestone would prove as productive as the upper wedge.

Lone Mountain.—The Electric Gold Mines Co., promoted by Frank E. Horton, manager of the Daisy in the early days of Goldfield, has sunk an 85-ft. shaft and has sampled the workings of the old Weepah, five miles west of the West Divide mine. The bottom of an 18-ft. single-compartment shaft is in \$14 ore. The silver content is small. The company is improving the road to the mine and when this has been completed an 18-hp. hoist will be moved to the claims.

Manhattan.—The American Onyx Co., operating a mine owned by Robert Maris, recently made a shipment of tubemill pebbles to the MacNamara mill at Tonopah. The product of the American Onyx is pebbles of silicified rhyolite, the market for which is reported to be improving after having had strong competition from Denmark. It is reported that the White Caps is to add a third shift of contractors in the mine. The cross-cut on the 800-ft. level is 325 ft. long.

Mina.—An electric power line from Millers to the Simon district is being surveyed by E. W. King, chief engineer for the Simon Silver-Lead company, and construction will commence some time this month.



The distance is about 38 miles. The line will be constructed and owned by the Simon Silver-Lead Mines Co. and will serve other properties that desire power. The Nevada-California Power Co., which will supply the power, has an application pending before the public service commission to discontinue the line from Aurora to Hawthorne, which has been set for hearing February 3. If the petition is granted the transformers, wire, and poles on that line may be purchased for the Millers-Simon line. Construction of the 150-ton mill at Simon is progressing rapidly and it should be ready to operate early in the spring.

OKLAHOMA

Picher.—In spite of the numerous shut-downs during recent months, about 70 mines, employing 2000 miners, are producing on a curtailed basis. Wages have been reduced throughout the district, and every possible measure of economy has been instituted. A few properties are being operated at Treece and Baxter Springs, Kansas, and near Hockerville and Zincville, Oklahoma.

UTAH

Gold Hill.—Daily shipments of 300 tons of low-grade fluxing ore are being made to the smelters from the mine of the Western Utah Copper Co. The company has made no reduction in wages, the rate still being \$6 per day. Excellent efficiency is being obtained and mining costs are said to be lower than in any other underground mine in Utah. On the 700-ft. level a cross-cut is being run to cut the ore-shoot at a lower depth.

Price.—The Ohio Oil Co., the Carter Oil Co., and the Midwest Oil Co. are prospecting on the San Rafael swell 50 miles south east of here. Near Huntington the Ohio company has started an 18-in. hole. It is planned to sink to 3500 ft. should the expected sand at 1800 ft. prove unproductive.

Purska.—Rescue car No. 11, of the U. S. Bureau of Mines, arrived here this week. The car, in charge of Carl Allen, is stationed near the Hutton Beck mine. With him are Dr. Murray, Bruce Johnson, and R. W. Clark. Mr. Allen states that the car will be kept here for several days, during which time men from various Tintle mines will be instructed in first-aid and rescue work.

WASHINGTON

Colville.—Two carloads of lead-silver ore have been shipped from the Old Dominion mine. The mine is operated by the Dominion Silver-Lead Mining Co., of which W. H. Linney, of Spokane, is president and manager. In the early days ore was hauled to Spokane in wagons. For a number of years the property was idle on account of litigation, which was cleared up last year. Several months ago a new company started work.

Northport.—The Indian Chief Mining & Milling Co. has been incorporated for the purpose of developing the Indian Chief group of five lead-silver claims near here. The capitalization is \$50,000.

Chewelah.—Plans for the consolidation of the United Silver Copper Co. and the Copper King Co., which own contiguous claims near here, on the basis of an issue of 1,800,000 shares of new stock at a par value of 25c. per share were presented to stockholders of the United Silver Copper Co. at a meeting held recently. The company during 15 years has produced \$2,000,000 in silver and copper ore and paid \$140,000 in dividends. It is incorporated for \$1,000,000. The Copper King has a large deposit of low-grade copper ore.

Spokane.—The Washington State Metal Mines Association re-elected the following officers at the annual meeting held recently: L. K. Armstrong, president; E. H. Knight, vice-president; M. E. Poole, secretary-treasurer. The following, together with the officers, constitute the board of trustees: H. S. Stoolfire, M. J. Sweeny, Dan Bagnell, J. L. Drumheller, and J. C. Haas.

MEXICO

Tampico.—The Mexican Petroleum Co. has mapped out an extensive development program for the current year, the largest item being the erection of a loading-station at Port Lobos, to be the terminus of a new 10-in. pipe-line from country south of Cerro Azul. At present the bulk of its oil is moved to Tampico, but as an extensive drilling program in the new southern territory is indicated, a loading-station at Port Lobos would be a great deal nearer than the station at Tampico. The company is building an addition to its railroad to permit transportation of needed materials for drilling in the southern district where 12 wells are being drilled. With five permits just received that had been held up by 'denouncements' under Carranza decree, the number of new wells is increased to 17.

Torreón.—The smelter here will resume operations soon. A few shipments of ore are now being received and a good supply of fuel is on hand. The Mapimi smelter, owned by the same company, the Metales y Minerales, will not be blown in until later. The ores from the mines of the company will be brought to Torreón for smelting in the meantime.——Martin C. Piton, prominent mining man of the Mapimi district, has filed on a large group of mines in the Cerro Blanco, under the name of La Tempiquena. He has taken out some fine specimens of silver and lead ore and anticipates being able to make shipments to the smelter soon.

PERSONAL

The Editor invites members of the profession to send particulars of their work and appointments. The information is interesting to our readers.

S. B. Dolbear has gone to New York.

W. L. Honnold, of New York, was here last Saturday.

M. L. Resqua has returned from New York to San Francisco.

John B. Richards, of Bishop Creek, California, has gone to Spokane.

John P. Benson has returned from Mazatlan, Mexico, to Berkeley, California.

R. C. Gemmell and D. D. Moffat have been in New Mexico and Arizona.

A. M. Yonge has returned from Porto Rico and is now living at Berkeley, California.

Paul Lincoln, manager of the Noble Five, at Sandon, B. C., is in San Francisco on a holiday.

Charles Bunting, locator of the Premier mine, in British Columbia, is at the Merrimae hotel.

J. M. Callow, of the General Engineering Co., of Salt Lake City, has returned from Superior, Arizona.

C. G. Newton, of Seattle, formerly with the Yukon Gold and Braden companies, is in San Francisco.

Ernest Bamberger, general manager for the Ontario Silver Mines Co. at Salt Lake City, is in New York.

George S. Ritter sailed on February 8 for Manila, where he will join the staff of the Benguet Consolidated Mining Co.

Stuart Croasdale and his associates, of Denver, have opened an office at Pittsburgh under the name of Stuart Croasdale & Co.

James Frame will spend six weeks or two months at Chalchihuites, Zacatecas, Mexico, where he is examining several mining properties.

G. W. Helntz, of Boston, vice-president in charge of Western operations of the United States Smelting, Refining & Mining Co., is at Salt Lake City.

G. B. Dennis, for many years president of the Northwest Mining Association, has been made honorary president and a life member of the Association.

G. E. Stephenson has been appointed assistant purchasing agent for the Ray Consolidated Copper Co., to succeed J. H. Browne, deceased. Mr. Stephenson's headquarters are at Hayden, Arizona.

Solomon R. Guggenheim has been elected president and chairman of the executive committee of the Braden Copper Co., succeeding W. C. Potter, who recently resigned to become chairman of the board of directors of the Guaranty Trust Co. of New York.

Sir Ernest Oppenheimer, a director in diamond and gold mines in South Africa, is making an extended trip in this country, visiting mining and metallurgical plants. He is accompanied by W. L. Honnold; formerly consulting engineer for the Brakpan Mines, at Johannesburg. They spent a couple of days in Utah recently.

At the annual meeting of the board of trustees of the United Engineering Society, on January 27, the following persons were elected officers of the society for the ensuing year: president, J. Vipond Davies; 1st vice-president, Calvert Townley; 2nd vice-president, W. L. Saunders; secretary, Alfred D. Flinn; treasurer, Joseph Struthers; and assistant treasurer, George H. Pegram.

THE METAL MARKET



METAL PRICES

San Francisco, February 8

Aluminum-dust, cents per pound.....	05
Antimony, cents per pound.....	8.00
Copper, electrolytic, cents per pound.....	13.50—14 00
Lead, pig, cents per pound.....	5—6
Platinum, pure, per ounce.....	\$70
Platinum, 10% iridium, per ounce.....	\$100
Quicksilver, per flask of 75 lb.....	\$50
Spelter, cents per pound.....	8.25
Zinc-dust, cents per pound.....	12.50—15.00

EASTERN METAL MARKET

(By wire from New York)

February 7.—Copper is quiet and firmer. Lead is inactive and lower. Zinc is lifeless and steady.

SILVER

Below are given official or ticker quotations for silver in the open market as distinguished from the fixed price obtainable for metal produced, smelted, and refined exclusively within the United States. Under the terms of the Pittman Act such silver will be purchased by the United States Mint at \$1 per ounce, subject to certain small charges which vary slightly but amount to approximately three-eighths of one cent. The equivalent of dollar silver (1000 fine) in British currency is 46.65 pence per ounce (925 fine), calculated at the normal rate of exchange.

Date	New York	London	Average week ending
	cents	pence	Cents Pence
Feb. 1.....	59.87	34.50	Dec. 27..... 63.77 41.03
" 2.....	66.50	36.12	Jan. 3..... 65.40 41.87
" 3.....	63.12	37.75	" 10..... 66.60 41.56
" 4.....	60.00	36.25	" 17..... 66.14 40.00
" 5.....	60.00	36.25	" 24..... 66.56 39.94
" 6 Sunday			" 31..... 64.52 38.16
" 7.....	60.50	36.00	Feb. 7..... 61.66 36.13
Monthly averages			
Jan.	1919 1920 1921		July 1919 1920 1921
Feb.	101.12 132.77 65.95		Aug. 111.35 96.23
Mch.	101.12 125.70		Sept. 113.92 93.66
Apr.	101.12 119.56		Oct. 119.10 83.48
May	107.23 102.69		Nov. 127.57 77.73
June	110.50 90.84		Dec. 131.92 64.78

COPPER

Prices of electrolytic, in cents per pound.

Date	Average week ending
Feb. 1.....	12.75
" 2.....	12.75
" 3.....	12.75
" 4.....	13.00
" 5.....	13.00
" 6 Sunday	
" 7.....	13.00
Monthly averages	
Jan.	1919 1920 1921
Feb.	20.43 19.25 12.94
Mch.	17.34 19.05
Mch.	15.05 18.49
Apr.	15.23 19.23
May	15.91 19.05
June	17.53 19.00
Monthly averages	
Jan.	1919 1920 1921
Feb.	5.60 8.65 4.96
Mch.	5.13 8.88
Mch.	5.24 9.22
Apr.	5.05 8.78
May	5.04 8.55
June	5.32 8.43

LEAD

Lead is quoted in cents per pound, New York delivery.

Date	Average week ending
Feb. 1.....	4.85
" 2.....	4.85
" 3.....	4.80
" 4.....	4.75
" 5.....	4.75
" 6 Sunday	
" 7.....	4.75
Monthly averages	
Jan.	1919 1920 1921
Feb.	5.60 8.65 4.96
Mch.	5.13 8.88
Mch.	5.24 9.22
Apr.	5.05 8.78
May	5.04 8.55
June	5.32 8.43
Monthly averages	
Jan.	1919 1920 1921
Feb.	71.50 62.74 35.94
Mch.	72.44 59.87
Mch.	72.50 61.92
Apr.	72.50 62.17
May	72.50 54.99
June	71.83 48.33

TIN

Prices in New York, in cents per pound.

Date	Average week ending
Feb. 1.....	4.85
" 2.....	4.85
" 3.....	4.80
" 4.....	4.75
" 5.....	4.75
" 6 Sunday	
" 7.....	4.75
Monthly averages	
Jan.	1919 1920 1921
Feb.	5.60 8.65 4.96
Mch.	5.13 8.88
Mch.	5.24 9.22
Apr.	5.05 8.78
May	5.04 8.55
June	5.32 8.43

ZINC

Zinc is quoted as spelter, standard Western brands, New York delivery, in cents per pound.

Date	Average week ending
Feb. 1.....	5.35
" 2.....	5.35
" 3.....	5.35
" 4.....	5.45
" 5.....	5.45
" 6 Sunday	
" 7.....	5.45
Monthly averages	
Jan.	1919 1920 1921
Feb.	7.44 9.56 5.86
Mch.	6.71 9.15
Mch.	6.53 8.93
Apr.	6.49 8.76
May	6.43 8.07
June	6.91 7.92
Monthly averages	
Jan.	1919 1920 1921
Feb.	7.78 8.18
Aug.	7.81 8.31
Sept.	7.57 7.84
Oct.	7.82 7.50
Nov.	8.12 6.78
Dec.	8.69 6.03

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, according to quantity. Prices, in dollars per flask of 75 pounds.

Date	1919 1920 1921
Jan.	11..... 50.00
Feb.	15..... 50.00
Monthly averages	
Jan.	1919 1920 1921
Feb.	103.75 89.00 50.00
Mch.	90.00 81.00
Mch.	72.80 87.00
Apr.	73.12 100.00
May	84.80 87.00
June	94.40 85.00
Monthly averages	
Jan.	1919 1920 1921
Feb.	100.00 88.00
Aug.	103.00 85.00
Sept.	102.60 75.00
Oct.	86.00 71.00
Nov.	78.00 56.00
Dec.	95.00 52.50

REVIVAL OF BUSINESS

America does not need a boom period to be prosperous, and the substantial factors of our national wealth will eventually bring about adequate revival of industry and commerce, declares James S. Alexander, president of the National Bank of Commerce in New York.

There are at present a number of great business forces clearly at work building a sound business structure for 1921. Supply and prices are becoming broadly co-ordinated to demand. The improvement in the liquidity of credit, which is now in progress, must develop further, but there are signs that improvement there will continue. As these movements are fulfilled, as wages and labor are re-aligned to new conditions, and as business finally absorbs the losses incident to deflation, stabilization on the new level will become an accomplished fact.

Normal activity must come from within business rather than from without. Business cannot idly wait for the public to resume active buying. It must stimulate buying by establishing a wide prevalence of substantially reduced prices for goods which must be based on increased efficiency in production and distribution, and the acceptance of reasonable margins of profits.

In this connection the growing tendency of labor to become more efficient and its willingness to accept liquidation of inflated wages is a most encouraging circumstance. From more than one point of view the readjustment now going on in respect to labor supply and demand is beneficial to the individual worker. The excess of jobs over workers, inflated wages, and lax supervision from employers which characterized the 'boom' period were all bad influences upon labor and contrary to its best interests.

Radicalism, encouraged by labor scarcity, invaded and depreciated the quality of labor as a component in our national economic life. High wages begot extravagance that soon reacted in rising prices, reducing the buying power of those very wages so that labor's gain was more apparent than real. There also developed a demoralization of individual efficiency because men were not kept on their mettle by competition for work and advancement.

With the return of more rigorous conditions it is becoming clear that the best interests of conscientious labor are served by a more normally balanced relation between labor supply and demand. Competition for work means the stimulation of efficiency and staunch Anglo-Saxon individualism as opposed to radicalism. An abundance of labor permits employers to choose workmen intelligently and to co-ordinate wages to their proper part in production costs, facilitating the establishment of price levels best for all.

But employers must play fair and not attempt to lower wages unduly or to enforce greater curtailment than circumstances warrant. They must recognize that, in any country worth living in, the standard of living tends ever upward. Wage earners in the United States are entitled to the opportunity to receive more than merely the means for a bare and joyless existence in return for real work well done. Any other attitude on the part of employers would be a menace not only to the orderly readjustment of existing conditions, but also to sound business progress in the long run.

I believe we are justified in confidence that these elements of progressive readjustments which are working toward better times are now greatly in the majority. The true need of business is, not stimulation of the forced-draught order, but rather a conservative response to better conditions as they develop.

MONEY AND EXCHANGE

Foreign quotations on February 8 are as follows:

Sterling, dollars:	Cable	3.88 1/2
	Demand	3.87 3/4
Francs, cents:	Cable	7.23
	Demand	7.20
Lire, cents:	Demand	3.70
Marks, cents		1.68

Eastern Metal Market

New York, February 2.

Extreme dullness pervades nearly all the markets. Prices are steady for some metals and weaker for others.

Demand for copper does not improve but the price-level remains unchanged.

Transactions in tin have been moderately good and the price has been fairly steady.

Demand for lead has quieted down with a slight easing in values.

The zinc market is the weakest of all and quotations are lower.

Antimony is softer because of the sharp decline in silver.

IRON AND STEEL

Pig-iron output was about 300,000 tons less in January than in December, indicating that steel production also declined, though perhaps less. The pig-iron total for the country was 2,405,845 tons, or 77,478 tons per day, against 2,703,855 tons in December, or 87,222 tons per day, according to 'The Iron Age'. The Steel Corporation, however, added 35,000 tons to its December output, while the independent companies made about 170,000 tons less than in December and the merchant-furnace output declined about 165,000 tons.

There was a net loss of nine independent steel company and ten merchant furnaces last month, while the Steel Corporation's gain was one. Active furnaces numbered 183 on February 1, against 201 on January 1.

Reports of foreign pig-iron and steel offered in this country are quite indefinite. Belgian basic pig-iron at \$28 or \$29, Atlantic seaboard, is not attractive, the possibility of German bars at 2.10c. on this side has aroused no interest.

COPPER

There has been no improvement in domestic demand. The few sales being made have been taken largely by small producers at 12.75c., delivered, for electrolytic with 13c. asked for February-March. These are the prevailing quotations though some large producers are asking not less than 13c. for prompt and early delivery. Lake copper is largely nominal at 13.25c., delivered. The somewhat sensational announcement was made yesterday that the Copper Export Association has sold 200,000 net tons of copper to Germany, the financing having been arranged on this side. No details are available. In an attempt to confirm this report your correspondent consulted a representative of one of the largest producers whose company is a member of the export association. The report was characterized as 'bosh' and entirely unfounded. Further light on the subject will be awaited with interest. News and trade papers seem to credit the report and publish it as a fact.

TIN

For the first time in some weeks consumers have shown more interest which has resulted in purchases but this has not been heavy. On Monday there were sales of future shipment amounting to 100 to 150 tons, comprising March shipment at 34.25c. and April shipment at 34.75c. Dealers were not in the market that day, an unusual incident. During most of last week dealers were buyers, in a quiet way, of considerable metal. There is a disposition on the part of consumers to desire higher prices so that they can cut down their loss on the high-priced metal they hold in stocks and they therefore hesitate as to just what course to pursue. Their manufactured products are in slightly better demand but the improvement is not pronounced. Prices for spot Straits, New York, have hung between 33 and 35c. during the week with the quotation yesterday at 33c. In London there has not been much change; quotations yesterday were £168

10s. for spot standard, £173 15s. for future standard, £187 10s. per ton for spot Straits, all of which are a little higher than a week ago. There is a rumor, unconfirmed but credited as probable, that the Malay government will reduce on February 8 its minimum quotation to £205. Deliveries into consumption in January are returned as 1555 tons with 2546 tons in stocks and landing on January 31. Imports for January were 1245 tons against 4195 tons in January 1920. Tin afloat is reported as 1395 tons.

LEAD

The market is much quieter and easier. There is more metal offered than there are buyers and this has resulted in a softening in values. Quotations in the outside market are 4.60c., St. Louis, and 4.85c., New York. The leading interest continues to quote 4.75c., both New York and St. Louis. The premium on spot of a few weeks ago has disappeared, there being no demand for this delivery. The opinion is expressed that the market cannot go much if any lower for conditions do not warrant it. The previous low was 4.50c., New York and St. Louis, in December, and this point is not expected to be reached on this movement.

ZINC

Although the advance in the pound sterling has practically eliminated the possibility of imports from England, there now hang over the market imports of German zinc. This is a serious matter in view of the present state of the market. While it is not believed that the supply of such zinc can be large, it is now large enough to be a big factor. It is reported that 10,000 tons has been contracted for delivery in this country and that 2500 tons of this is known to have been sold at around 5.30 to 5.50c., seaboard. The fact that zinc can be made in Germany from German ore and shipped here at around 3c. per pound, seaboard, duty paid, is the serious phase. In Eastern markets there is already competition from this source but it hardly extends to Pittsburgh and even in the East some consumers will not use it. With the market as dull as it is, it is an important factor. Prime Western in the absence of demand of any consequence has fallen to 5c., St. Louis, or 5.50c., New York, with the imported metal available at 5.25c., seaboard, though actual information about this is hard to get.

ANTIMONY

Wholesale lots for early delivery are lower at 5.25c., New York, duty paid, largely because of the decline in silver to new low levels recently.

ALUMINUM

The virgin metal, 98 to 99% pure, is quoted by the leading interest in wholesale lots for early delivery at 28c. f.o.b. producer's plant with the same grade from other sellers available at 24 to 25c., New York.

ORES

Tungsten: There is very little, if any, business, the market apparently waiting for a decision on the tariff question which seems hardly likely to mature at this session. Holders ask \$3 per unit for Chinese ore.

Molybdenum: The market is inactive with quotations nominal at 50 to 60c. per pound of MoS₂ in regular concentrate.

Manganese: There is no business. Quotations are nominal at 35 to 40c. per unit, seaboard, for high-grade foreign ore.

Manganese-Iron Alloys: Ferro-manganese is in light demand at \$100, seaboard, for the British and \$105, delivered, for the American alloy. Spiegeleisen is inactive at \$40 to \$45, furnace.



T. A. RICKARD, Editor

UNDER 'Discussion' we publish a letter from Mr. W. J. Loring, the president of the American Mining Congress, on the McFadden bill, the purpose of which is to assist the gold-mining industry by levying an excise of \$10 per ounce on all gold used in manufacture and to pay the \$10 thus collected to the producers of new gold. Our own doubts as to the wisdom of this proposed law have not been removed, much as we would welcome anything likely to help the gold miner, but we are pleased to publish Mr. Loring's letter, which is all the more interesting because it was not intended for publication. As for the McFadden bill, we have said enough about it.

OUR contemporary at Spokane, 'Northwest Mining Truth', has been a consistent foe to the smelter trust and would therefore be expected naturally to chuckle over the attack made by Mr. Karl Eilers on the Guggenheims, but we think the editorial comment appearing in its issue of February 2 is unfair to the 'Engineering and Mining Journal' in so far as it describes a recent editorial on the subject by our New York contemporary as "the most pitiful exhibition of toadyism", "abject fawning", and a "defence of those who have broken faith with the public". This seems to us an unjustifiable description of the humorous article on the A. S. & R. company's troubles. We have taken them rather seriously ourselves, but we know of no justification for so bitter an onslaught upon "the few kind words that the 'Engineering and Mining Journal' has handed them [the Guggenheims] on its knees". Our contemporary in New York owes no fealty to those "who have milked dry the largest concern of its kind in the history of mining", as the Spokane paper characterizes them, but it does show the influence of propinquity and appears unable to understand how important and serious the subject is to those in the West who produce ore that has to go for treatment to the custom smelters. To them the Eilers-Guggenheim controversy is tremendously suggestive and to them it makes a great difference as to who is to control, and what policies are to control, the American Smelting & Refining Company.

MINING companies that tap subterranean water-channels in driving adits or tunnels can establish no claim to the resulting flow of water, according to a decree rendered by the U. S. Circuit Court of Appeals at St. Louis on February 5, in the litigation between the Snake

Creek Mining & Tunnel Company and the Midway Irrigation Company. The finding of this Court reverses the decision of Judge Tillman D. Johnson of the District Court of Utah, wherein the Snake Creek company, now merged with the Judge Mining & Smelting Company of Park City, was awarded the right to the water after establishing the contention that it was 'percolating'. The facts in the case were reviewed in our issue of October 30, 1920. The diversion of some 14 second-feet of water, which flowed out of a long adit driven by the Snake Creek company, rendered worthless some 1500 acres of highly productive farm-land. This latest decision guarantees the irrigation company title to all the water flowing from the adit, and enjoins the mining company perpetually from asserting any claim to it. We wonder if the Judge company is to be compelled to pump the water back again, up the canyon, or if it will be forced to bulkhead the adit and thereby revert the flow to its original channel. It will be interesting to see the full text of the decree, and also to learn whether an appeal will be taken to the Supreme Court. The decision is especially important to mining companies owning property in the neighborhood of streams that supply water for irrigation.

PROFUSE printing is one of the weaknesses of our day. A select committee has been investigating the printing and stationery expenditures of the British government, with the result that it reports a total annual cost of £6,000,000, as compared with £1,200,000 before the War. "A large part of this heavy increase in expenditure", says the committee, "must be set down to the propagandist zeal of various departments, which employ numbers of journalists and others to advertise their activities." This might easily have emanated from an investigating committee at Washington, where an orgy of printing and circularizing has been one of the sequelae of war activities. It continues, as we know by the large amount of paper that comes to us daily and that we rescue from waste by writing on the unspoiled back. To "employ numbers of journalists" is a venial sin, but to employ "others", presumably also in large numbers, is a crime; and together the performance is wasting an enormous tonnage of paper at a time when that commodity is profiteeringly expensive. Apart from this phase of the matter, it is highly undesirable that those in office should use the public money—the taxpayers'

tribute—to aggrandize themselves by their propaganda. The heads of Departments at Washington did it lavishly and unflinchingly, even to the promotion of their candidacy for the Presidential nomination. It is hardly surprising that some of the lesser fry did it impudently. Whatever excuse for it may have been found at a critical period when it was necessary to mobilize the national sentiment in behalf of the whole-hearted waging of war, there is no excuse now. Thrift should begin at Washington and it might well begin in the saving of paper, printing and postage.

SO the financing of copper exports proves true, and we are glad to record the fact. A powerful syndicate of bankers has issued \$40,000,000 of 8% gold notes in behalf of the Copper Export Association, which includes most of the principal copper-mining companies and represents 75% of the copper production in this country. These notes mature in periods of one to four years and are secured by 400 million pounds of copper; the time for which they run will suffice for the marketing of the metal abroad in an orderly way and will relieve the producers of the financial burden of carrying the large surplus that has been menacing the market. The present rate of production is below the rate of deliveries of copper in 1919 and 1920, and the 400 million pounds, thus to be liquidated, represents an amount equivalent to only three-fourths of the export trade done by this country last year, so the market should experience great relief at once. The successful flotation of this loan will permit the companies to dispose of their accumulation of metal and will facilitate further development of their mines in anticipation of the time when trade with Europe regains its normal status. The companies participating are the Phelps Dodge Corporation, American Smelting & Refining, Calumet & Hecla, Utah Copper, Chile, Kennecott, Braden, Ray Consolidated, Nevada Consolidated, Inspiration, Greene-Canaana, New Cornelia, North Butte, and Utah Consolidated. This association agrees that one-third of its monthly shipments abroad shall be withdrawn from the trustees for the syndicate and that 12½ cents per pound shall be paid into his hands, either in cash or notes, for all such copper thus withdrawn. It is claimed that arrangements have been made for the transfer of large quantities of the metal to European purchasers. Altogether the event is one of great importance and of good augury to the mining industry of the United States.

THE contention that 'the shoemaker should stick to his last' is losing force. More work and work of a more varied character can be done during man's allotted span because of greater facilities and the elimination of waste. There is also a sense of invigoration in the tackling of something new, and this is an asset to the individual who, realizing that his actions are under the greater scrutiny, makes an unusual effort and often succeeds remarkably well. A short while ago a concern in the East advertised for a business-man to fill a position requiring a considerable amount of analytical and con-

structive ability. "What experience have you had in this particular field," he was asked. "None," was the reply, "and that is precisely why I consider I am suited. I have proved my capability in other work. I shall look upon every problem here from a fresh and unbiased viewpoint. If you care to make the experiment, I feel sure that I can make good." And he did. Capable mining engineers, too, usually find their feet when given responsibility in other branches of work, although many well-managed corporations do not realize their ability to extend operations into other fields of endeavor. We were particularly impressed recently to see the highly efficient way in which the management at the mining camp of Cerro de Pasco, Peru, was conducting a furniture factory, provided with the most modern equipment and labor-saving devices. The unskilled Indian, of low earning capacity under ordinary conditions, was becoming highly proficient; and the 'mission' furniture produced, although plain and serviceable as befitting employees' houses in a mining camp, compared favorably with the products of high-grade American factories. We came to the conclusion that, if considered worth-while, the Cerro de Pasco Copper Corporation could without difficulty capture a large proportion of the furniture business in Peru, as well as in adjoining countries. Not only was the factory being run on efficient and economical lines, but it was obvious that no interference was caused with regular routine mining work, an evidence of the fact that the entire operations were under the control of a capable executive. Good organization permits successful expansion; and it is no longer true that *ne sutor supra crepidam* when events are proving that his experience and the added ability gained by experience are sufficient to justifying him in seeking 'pastures new' whenever there is good prospect of success. We are interested in the report that the Alaska Gold Mines Company is planning to convert some of its mills and to utilize some of the available water-power for the production of wood-pulp. Spruce forests adjoin some of the properties belonging to the company, and the adaptation of a considerable part of the equipment on hand may be feasible. The controlling engineers are capable, and a change of luck in the fortunes of the company would be well deserved.

MERE smallness is a quality not to be despised; most things were once small. Mines and mining districts, like everything else, have humble beginnings. Every producing mine was once a prospect; courage, energy, and time have been required to make its exploitation a success; and generally there have been sceptics who ridiculed the possibility of developing a profitable enterprise. It must be confessed that the consistent pessimist was right more often than he was wrong for the reason that most prospects prove to be worthless or nearly so; only one in a thousand grows to be a real mine. One of the old 'camps' to awaken to new life recently is Cooke City, Montana, situated some 56 miles east of Gardiner, the gateway to the Yellowstone National Park. The inaccessibility of the district has always been a serious drawback, but recently the Western Smelting & Power

Company, controlled by Seattle mining men, has undertaken the exploitation of the immense deposits of copper-silver-gold ore of which Henderson mountain is said to be composed. The company has built a hydro-electric power-plant, a transmission-line, and some 50 miles of road; a series of adits has been driven into the mountain, and a small copper smelter will be ready for operation within four months. The investment already made is said to exceed half a million dollars. An important factor in the progress thus far made is the modern motor-truck. The road between Gardner and Cooke City has been put in good shape and the round trip with a full load can be made easily in a day. One engineer estimates 1,110,000 tons of ore worth \$46.34 per ton as being an "insignificant fraction" of the total ore-reserves; the same gentleman declares that he is not exaggerating when he says that "the Cooke City district far exceeds the wealth of Butte". This is large talk about what is, so far, a small mine; it shakes one's faith in the credibility of the writer. We know, however, that some conservative engineers have been favorably impressed with the district, and we feel justified in predicting the probability of a prosperous future for Cooke City, even though the well-known riches of Anaconda hill may not be so eclipsed as to sink into insignificance.

MR. C. M. EYE'S article on 'Packing for Export', which appears on another page of this issue, indicates the importance of attention to matters that are often neglected by engineers, whose time is taken up later in attempting to remedy the troublesome conditions arising from such neglect. Indifferent and careless packing and marking leads to loss and breakage, endless correspondence and delays, the waste of good talent needed to effect repairs, and the deflection of much business energy. Mr. Eye, whose successful work in the Philippines gives him the right to speak with authority on such matters, deserves credit for the example set and the impression given that whatever is worth doing at all is worth doing well. It is largely through the avoiding of waste of time and labor—a waste resulting from the necessity of having to pay continual attention to unimportant details—that the successful engineer achieves so much. Manufacturers and merchants in the United States are tardy in realizing the importance of such details; but unless they are prepared to study the question there will be constant disappointment abroad and loss of custom at home. We use the word 'study' advisedly, for we remember an instance in which the exporting firm had fully realized the necessity for careful packing before shipment, even to the sealing of the package in a case with soldered joints; for the apparatus, of somewhat intricate design and workmanship, had to pass through the tropics before reaching its destination. They used care, but no thought. The sealed case kept out the moisture of the tropics but it did not exclude the heat. The apparatus was packed on a damp day and in a damp warehouse, the humid atmosphere was sealed in, and the heat of the tropics, in conjunction with the trapped moisture,

damaged the apparatus to an irremediable extent. Such an example as this indicates that no detail of packing or marking is unworthy of attention by manufacturers anxious to receive encouragement in the form of repeat orders from overseas; and for this reason we welcome Mr. Eye's contribution as indicative of a desire on the part of engineers to co-operate with American industry, as well as to facilitate mining expansion in tropical countries.

Colorado School of Mines

Friends of the Colorado School of Mines—and it has many—will regret to learn of the further development of unsatisfactory conditions. These are emphasized by the resignation of Mr. C. Erb Wuensch as editor of the 'Colorado School of Mines Magazine', a monthly periodical conducted under the auspices of the Alumni Association. Mr. Wuensch has aroused the antagonism of Dr. Victor C. Alderson, the president of the School, and the dislike of the trustees, by his criticism of them and by his publication of the condemnatory report, on them and their administration, by a select committee of the American Association of University Professors, to which we referred at some length in our issue of September 11, 1920. This rumpus was inevitable, for the tone of Mr. Wuensch's remarks in the December issue of the Magazine left no doubt as to his hostility to the powers that be; he might, we think, have been less violent in his language, which was such as to make it certain that one of the contending parties would have to quit the field. In the January issue of the Magazine we are shown the correspondence in the case, as well as a number of letters from alumni. It is evident that the old students of the School are not in agreement as to the proper course to pursue, and their position is rendered all the more difficult by the fact that the president of the Board of Trustees is an alumnus who seems to be working with Dr. Alderson and the other trustees. The letters published by Mr. Wuensch indicate that many of the old students dislike intensely the idea of placing the School under the regency of the State University, which centres at Boulder, and that the fear of this subordination of their alma mater causes them to depreciate the attacks made upon Dr. Alderson and the trustees. Of course, as the Secretary of the Alumni Association says, the School belongs primarily to the citizens of Colorado, not to the alumni only; unfortunately the people of the State are not correctly informed concerning the facts, because, among other factors, one of the trustees is the mining reporter on the principal newspaper of Denver and moreover the selection of the trustees is in the hands of the Governor, who, of course, plays small politics. Just now the School is flourishing, in point of the number in attendance, as are all the other mining schools of the country, this being one of the after-effects of the War period, so that the dissensions among its friends appear to have had no adverse effect. The faculty is in a continual state of flux, three having resigned since July and two others being about to do so. Indeed, according to Mr. Wuensch, the oldest

member of the present faculty has held office for less than four years. As our readers know, we sympathize with those who deprecate Dr. Alderson's methods and more with those who consider the trustees insufferable, particularly the older members of the board, who are entirely unfit to guide the destinies of an educational institution, but we conclude that not much can be done, as it now seems apparent the alumni are unable to agree upon a plan of campaign. To us it appears reasonable and logical that the School of Mines should be a part of the State University system, particularly as its present control has proved so inefficient, for the change can be brought about without moving the actual site of the School from Golden to Boulder. The chief lesson of the scandal is the need for resewing the educational institutions of a State from the hands of the politicians, and that can be done only by direct election of the trustees by the people or, better, by selecting the majority of the trustees ex officio from among the leaders of the mining profession in the State, as we suggested last September.

Institute Membership and Professional Status

We publish two letters protesting politely against our assumption that a mining engineer is not in good standing if he be not a member of the national engineering society. Mr. P. B. McDonald insists that membership is a matter of personal choice, like joining any other fraternity or mutual-benefit organization, but we demur to this view because our Institute aims to be, and comes near to being, completely representative of all American mining engineers of good character and proved ability. The longer letter from Mr. F. C. Smith calls for fuller comment. We join with him in his kindly reference to Professor Pettee, whose memory we shall never cease to honor and to whom many volumes of Transactions owe more than is generally recognized by our members. Mr. Smith tells us why he resigned, and we can go part of the way toward understanding his reason for doing so, but it did not occur to us or to others at the time that it was necessary to resign just because things went wrong temporarily. Such troubles befall even the best regulated organizations; and when they happen it is best, not to withdraw, but to come forward with constructive criticism. Mr. Smith questions the selectness of the Institute's membership and asks how many hold a college degree of mining engineering. We are unable to answer his question, but we would hazard the guess that 25% of the members are graduates in mining engineering and 40% in all have degrees in mining or metallurgy; also that 70% have degrees of some kind. Undoubtedly the higher requirements and the greater care taken in electing new members during recent years have improved the quality of the membership in so far as it can be assured by artificial criteria. However, the difference of numbers between the Institute and the Mining and Metallurgical Society remains a standing commentary, if not a standing joke, on this phase of the problem, for the exclusive society has 300 members and the inclusive one has 9500.

Mr. Smith suggests that membership in the Institution of Mining and Metallurgy, which represents the British mining engineering profession, means more than a like status in our own Institute. To this we would say that the British organization includes 2400 men, of whom only 950 are full members, the others being associates and students. Of the members, 91 are resident in the United States, and it must be conceded that they constitute a group of widely traveled men, most of whom enjoy an international reputation, or, to be more precise, they are well known both in New York and London. The membership of scarcely one thousand in the London society does represent a selection of men so qualified by training, experience, and character as to accord them a definite status in the profession. The mining activities of the British dominions centre in London to such a degree that it is easier to scrutinize the eligibility of those proposed for membership than is practicable in our own country, in which a number of mining and financial centres serve as headquarters for the profession. To be a British mining engineer and not to be a member of the Institution does indicate a lack of status. So definite an inference cannot be drawn regarding an American mining engineer whose name does not appear on the roster of our Institute, but even after allowing for those who have been so disgruntled or irritated by minor happenings as either to resign or to decline a membership for which they were eligible, and making allowance for the type of man who is non-gregarious and non-coöperative, and therefore remains detached, it still is true in a broad way that an American mining engineer in good standing is usually a member of the Institute, and therefore the converse generally holds true: if he be not a member he is probably, although not certainly, in poor standing in his profession. Any individual, however, such as Mr. McDonald or Mr. Smith, may, by known character and proved ability, be so well recognized by the members of his profession as to render his non-membership of no great consequence to himself; but we venture to say that if a comparatively unknown man, whose name is not to be found on the roll of the Institute, comes into the limelight of newspaper publicity as an American mining engineer, one is fully warranted in doubting his status in the profession; although, in this case also, later information may prove that his work and achievements are such as to remove any reasonable doubt concerning his qualifications. One word more: The claim to membership in a professional society may mislead, for the reason that a man's character and ability change during the course of his life. An engineer who is fit and competent at 35 may be unfit and incompetent at 50; an unfortunate marriage or the acquirement of bad habits may undermine both the character and ability of a man as he grows older. Many members would fail of re-election ten or twenty years after joining an Institute or Institution if they were obliged to undergo an examination. On the other hand, young men black-balled or otherwise excluded at one stage of their lives may so improve in character and so gain in ability as to be eligible later on. "Who hath

made thee a judge over us?" Every effort to classify men is open to criticism because none of us can read the motives of others, nor estimate confidently their moral qualities. Whited sepulchres flourish in positions of honor, and the victims of circumstance are buried in ignominy. It is a difficult and an ungracious task to appraise professional men, yet it has to be done for the sake of solidarity on the one hand and the protection of the public on the other. If the Institute is not representative in the eyes of Messrs. McDonald and Smith, the best thing they can do is to join it and make it just that much more nearly representative.

The Domestic and Foreign Supply of Nitrate

The amended nitrate bill, which embodies proposals brought forward by the War Department, passed the Senate on January 14. The original measure, which proposed the creation of a Federal corporation for the purpose of operating plants to manufacture nitrogen products, is of moment to those interested in national defence and economy or in professional or trade expansion in South America, and has been under discussion for several weeks. The amended bill may be classed among parliamentary fatalities; for the financial conditions imposed upon the new corporation are such that a successful outcome is impossible without the adoption of a paternalistic policy of protection that would abnormally increase the cost of nitrogen products, both to the War Department and to agriculturists. The crux of the question is seen in the requirement that if at the end of any fiscal year the corporation has not earned sufficient to meet the interest payment on bonds, it shall cease operations until authorized by Congress to resume. Such a stipulation is an absurdity in the case of an industry that has hardly passed the experimental stage, and in connection with which there is no evidence to indicate that competition along commercial lines with products now on the market could possibly be successful. The profit requirement, as stipulated in the amended bill, will serve only to kill initiative along one of the most important avenues of research, of vital importance to national defence; for chemists and engineers of reputation will hesitate before they associate themselves with a venture of doubtful outcome—one that is, in the opinion of many, foredoomed to failure. And failure is inevitable unless steps are taken to increase the selling price of nitrate products by the establishment of a protective tariff against importations from Chile. And in view of the necessity for a decrease rather than an increase in the price of a commodity so vitally connected with the cost of living, such an action would be deplorable, and would place the United States at a serious disadvantage.

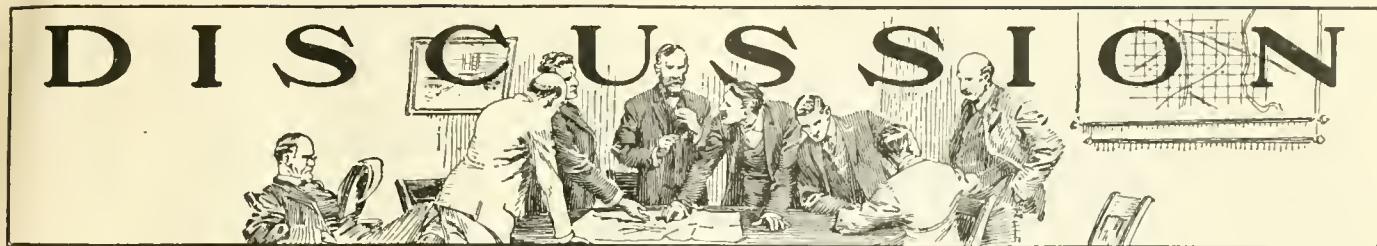
So far as competition with the Chilean product is concerned, the following considerations deserve attention: The imported article is more suitable, for both munition and agricultural purposes, than any of the synthetic compounds to be manufactured at Muscle Shoals. Chile now reaps an annual income of about \$40,000,000 from the

export-tax on nitrate. With the approach of any prospect of commercial rivalry from the competition of a synthetic product, this export-tax would be reduced *poco poco*, and so the cost of the natural product would be cheapened to the ultimate consumer, who now pays the tax, though indirectly. Whatever happened, the natural nitrate industry would be held intact, and, if necessary, revenue would be gathered from other sources. But Chileans are far from feeling discouraged at the outlook, because their country holds the world's monopoly of nitrate in commercial deposits. During the War the bogey of synthetic nitrate was used to frighten them, but, as nothing eventuated after the Armistice, they now know that the scare had no foundation; and the Chilean industry is in a stronger position than ever. Further, recent developments of a technical character have demonstrated that, provided scientific and large-scale methods of operation are adopted, the cost of production will be reduced considerably in the near future, and immense quantities of low-grade caliche and residue, previously considered valueless, will be available for profitable extraction and treatment. Improvements in technique and a more intelligent management of technical operations on the Chilean pampa are inevitable. American engineers as yet have interested themselves almost entirely in the commercial aspect of the problem: the sale of plant equipment to the owners of oficinas, and the reaping of commissions. Large-scale operation has been pooh-poohed and discouraged as impracticable and against the laws of the country—as if Chile would put obstacles in the way of a progress that would increase enormously the value of the nitrate pampa to the nation and cheapen the production of crops throughout the world! The real reason for the objection lay in the fact that large-scale operation would preclude the possibility of the adoption of the complicated processes and the use of the expensive equipment that have been advocated by salesmen-engineers, who seem to dominate the industry as far as technical modification of procedure is concerned.

A propaganda was set in motion in the United States during the War, which hinted that attention paid to the technique of the Chilean nitrate industry would be looked upon in some quarters as an evidence of lack of patriotism, and indicative of a refusal to support loyally the efforts of American engineers and chemists to produce a synthetic substitute. One result of cumulative discouragement and lack of initiative is that, according to the last issue of 'Mineral Industry', only 2.52% of the total output of nitrate was obtained from oficinas belonging to American owners, whereas British interests controlled 37.76%. The Jugo-Slavs, recognized in South America for their acumen and business ability, are steadily increasing their holdings in the Antofagasta district, and before long will control a large proportion of the industry in that part of Chile. There is an immense field for independent American engineers—for men who are disinterested in the sale of patented machines, who realize the importance of a clear understanding of the fundamental principles in the operation of chemical processes,

and who have ideas big enough to still the croakings of the local pessimists who are content to point to the failure of unsuitable and complicated equipment as the reason for lack of initiative to think beyond early Victorian technical methods. However suitable these may have been fifty years ago, they are certain to be displaced by modern ideas, permitting large-scale and economical operation; for the Chilean nitrate industry is not likely to remain indefinitely a single exception to the spirit of advance. The price of nitrate nominally is controlled by an association consisting of Chilean and foreign owners. The absurdity of this method of price control is seen in the fact that during November the actual market for nitrate was about 13s. 6d. per quintal (about 100 pounds), whereas the price set by the association was about 17s. 3d. The few American companies operating in Chile, thanks to their subordination to American anti-trust laws, are not members of the association. Further interest in the industry by American corporations and individuals would tend to abolish or minimize the evils caused by the restriction of sales of Chilean nitrate owing to the prohibitive price set by the association. With regard to possible competition with synthetic products, it must be admitted that Chile will hold the field for the cheap production of nitrate for some centuries to come. On the other hand, and to meet present and future military requirements in the United States, it is obviously a sound policy to initiate work that will obviate dependence on Chile in time of war. The active co-operation of the United States in the winning of the Great War would have been rendered impossible without the availability of almost unlimited supplies of Chilean nitrate; and these supplies were obtained only by the assistance of the British, who hold a large share, as already mentioned, in the Chilean nitrate industry. Had a certain hint made to a prominent naval official—that it was immaterial as to which nation the United States engaged in war, Great Britain or Germany—been taken seriously, the question would have arisen as to how the United States could obtain the necessary nitrate for the manufacture of explosives. And now the prospect of obtaining a supply of synthetic nitrogen products in the United States is still further pushed into the dim future by the action of Congress in insisting on the operation of the Air Nitrates Corporation as a commercial undertaking. Such a policy can do nothing to reduce dependence on Chileans, British, or, possibly, Jugo-Slavs, for the supply of nitrate in times of peace or war. A lesson can, however, be taken from Germany's attitude: Prior to 1914, immense plants were built, and processes perfected as far as was possible, with the help of the best scientific and technical skill available; but even with the comparative cheapness of operating conditions in Europe at that time it was obvious that the expenditures were solely in anticipation of a war-time necessity. The proof of this assertion is found in the fact that Germany was largely interested in the Chilean deposits before the War, and imported vast quantities of the natural product so long as it was possible to do so. The perspicacity of the Germans in realizing at

an early date the small commercial value of their synthetic nitrate plants, and, in consequence, laying up large stocks of Chilean nitrate, was a contributing cause to the success of the stubborn defence and bold offence that characterized their military operations during the earlier years of the War. With the exhaustion of these stocks of natural nitrate and the enormous cost and great difficulty of manufacture of the synthetic product came a realization of impending disaster; and the difficulty of obtaining a sufficiency of nitrogen products at a moderate cost was doubtless a contributing cause to the signing of the Armistice. From these facts it would seem wise to deduce that, so long as ships are available to carry the product, the nitrate from the Chilean pampa must inevitably hold the field against any synthetic products, especially in view of the imminence of the introduction of large-scale operation and more efficient beneficiation of the caliche, both of which will, naturally, have the whole-hearted co-operation of the Chilean government. There is no sense in the United States entering into competition with Chile at the present time in the matter of nitrate. There is no sense in killing the domestic synthetic nitrate industry at its birth by imposing conditions that must inevitably lead to disheartenment and failure. A vast amount of capital must be put into research and operation before a steady output of a suitable product can be assured. The undertaking must not be confused with a commercial business. With a realization of the facility with which Chile can reduce the cost to the consumer—by lopping the export-tax and by the adoption of improved technical methods—no individual or group of individuals can be expected to enter the synthetic nitrate business with any hope of meeting expenses, much less operating at a profit. The undertaking must be considered as one primarily for the purpose of provision in the event of war and the cutting-off of supplies from Chile. It must be financed, and financed liberally, by the Government. It must be operated experimentally until efficient results are secured; and during such time the work must not be hampered by considerations of profit or loss. Unless the matter is treated as a scientific investigation there is little hope of ultimate success; and it is only under such conditions that the best chemical and engineering skill of the United States will be available for the solution of a problem which it is admitted on all sides is of vital importance to the country. In the meantime it is to be hoped that American engineers and financiers will take an increasing interest in Chilean nitrate, ignoring any absurd imputation of disloyalty to the United States in furthering an industry that, unfortunately for us, happens to be monopolized by a foreign country, with which we are and expect to remain on the most friendly of terms. We must realize the economic importance of an interest in that industry in proportion to our needs. The longer the question is shelved the greater will be the opportunity for others to study the question and to act in a manner commensurate with the vast possibilities of success, in the technical as well as in the commercial aspect.



Status as a Mining Engineer

The Editor:

Sir—In your issue of January 15, under 'The Vanderbilt Concession', you make the somewhat broad assertion that "most of the few engineers conspicuous by their detachment from the national organization—the American Institute of Mining and Metallurgical Engineers—are what we call cranks; therefore, if a mining engineer is not a member of the Institute, it is fair to say that he is not in good standing as an American mining engineer".

This airy persiflage may have been written for the purpose of "getting a rise" out of the alleged cranks, or possibly with the purpose of increasing Institute membership as an economic measure—the reduction of the present \$27 per capita tax; however, as it is not generally known that the profession of mining engineering has been unionized to the extent of black-listing detachees from the Institute, or to the extent of taxing engineers with advertising costs of which they may not discern either the need or the value, it is barely possible that courtesy demands some further enlightenment, to the end that those unfortunates beyond the pale may, possibly, see the error of their ways.

The writer became a member of the Institute a good many years ago—in 1884, if memory serves—under the kindly introduction of the late W. H. Pettee, Professor of Mining in the University of Michigan, who for many years read all of the manuscripts and corrected all of the proofs for the Transactions; going over every calculation and formula with the microscopic care so characteristic of all his work. Professor Pettee had been an associate of Dr. Raymond, the father of the Institute, at the Freiberg mining-school, and these men, with others of similar character and worth, seemed to set up certain standards that rendered membership in the A. I. M. E. a valuable and agreeable association, while they lent the Institute a true dignity, which, to some extent, has perhaps passed away with them. The membership was continued for something like 25 years, when occurred what seemed to be a somewhat disgraceful squabble over the election of officers; then went glimmering (if your dictum is correct) all remnants of "good standing as an American engineer", for the writer experienced what may be termed a sense of repletion, and resigned; a momentous act, which, if the truth must be told, has been equally innocuous to both the Institute and himself.

Readily admitting that membership in the A. I. M. & M. E. constitutes association with much of the best in engineering circles, and that its list of members consti-

tutes a convenient directory (to some such an extent as the lists of engineers advertised in the 'Mining and Scientific Press' and the 'Engineering & Mining Journal') there yet seems to be some slight question as to just what definite ability, or character, or education is in any way established by such membership; such, for instance, as rather particularly attends membership in the Institution of Mining and Metallurgy of London. Without exact knowledge of the Institute's membership requirements today, it is not so very long ago when practically anyone (with or without knowledge of mining engineering) might become a member by proper introduction and payments of fees—a condition somewhat liable to upset any very definite status for its members. To the same extent that the precise educational requirements of certain foreign schools predicate definite knowledge for their graduates (Swiss medical schools, for instance), it is not to be denied that an E. M. degree from a sound college or university might be considered as the only proper basis for our use of the title of Mining Engineer. We all recognize ability and efficiency in many mine-operators or engineers who have been, in a way, self-educated, and who have never perhaps entered the doors of a college; while we are also familiar with a few cases in which graduate mining engineers have most distressingly lacked the practical training so desirable and necessary. But, fully recognizing these conditions, abundant reasons still remain whereby the unaccredited use of the title of Mining Engineer maintains quite the impropriety of similar misappropriation in other professions; and it might be interesting to know just what proportion of the members of the Institute actually hold the degree of E. M. Possibly you, sir, can supply the information.

Chloride, Arizona, January 25.

F. C. SMITH.

The McFadden Bill

The Editor:

Sir—I need not call your attention to the deplorable condition of the gold-mining industry in the United States, and more particularly, may I say, in California. This deplorable condition has been brought about by causes over which we, as gold-producers, have had no control, but we do feel, as gold-producers, that we have some control, or at least we should exert ourselves toward attempting to control our future destiny and before it is too late to save the gold-mining industry, not, as some would say, from total extinction, because that would be impossible, but from gradually decreasing until it will take a very minor place in comparison with the impor-

tant position it had held up to the beginning of the War.

You know the intention of the McFadden Bill and I know that you have not been altogether in favor of this measure, which I somewhat regret, but it would appear to me that we as gold producers, and you, presumably an exponent of the mining cause, should pull together in obtaining such relief as the McFadden Bill might eventually give us, or at least until some other measure is brought forward that is more suitable in the opinion of the majority than the McFadden Bill.

It appears to me that we should not overlook the fact, which government records substantiate, that the production of gold is dropping off each year and unless something is done, and done almost immediately, it will be too late to save the industry from drifting into a condition that I am very much afraid it will never recover from.

The idea that the gold-producers will be compensated in the end, for the losses made during the period when high prices have prevailed, by enjoying normal conditions in the future appears to me to be about the worst argument that can be put forward. What are we going to do with the large low-grade gold mines in the United States, such as the Homestake? This mine, when costs became excessive, ceased breaking ore and is drawing its shrinkage-stopes, with the result that when the broken ore has all been drawn out of the shrinkage-stopes the mine will be ruined, because the backs cannot be reached and therefore no milling ore can be broken in the mine for that reason. It is probably too late at the present time to save certain sections of the Homestake. I refer to this as an example of what is going on all over the country. Worse still, mines now being operated are selectively stoping the best ore, leaving what before the War would have been highly payable. Those low-grade sections have already been developed, the equipment has already been paid for, and it would appear to me to be a great pity to allow the millions of ounces of gold contained in the low-grade ore that has been developed in our country to remain unused, practically lost forever.

It is the intention of the American Mining Congress to do everything within its power to bring about the passage of the McFadden Bill and thereby save the gold-mining industry from almost total extinction, and to at the same time produce gold which is necessary to maintain the financial integrity of the nation.

You may take issue with me upon the small part that the production of gold in the United States plays in maintaining the integrity of the nation, but however small it might be, it is certainly a step in the right direction and, after all, we work upon a gold standard and whatever gold is produced is certainly assisting to maintain that standard. If every country in the world was subjected to a depleted gold production we would soon find ourselves in a very deplorable condition.

It is interesting to know that in California alone from 1848 to 1920 the enormous sum of \$1,720,496,203 was produced, which in itself is within shooting distance of the normal gold reserve of the United States.

It is proposed to call a meeting, the date of which you

will be informed of later, at which I hope to see the faces of not only the gold-producers of California, but other business men who are benefited directly and indirectly by the gold-mining industry of this State, and I further hope that we will receive the financial support of these good people, which is absolutely a necessity in order to carry through this campaign, which we have begun and which we intend to stimulate with all the power that we possibly can bring to bear upon the subject.

It is my sincere wish that you give this matter your most serious consideration and assist us as far as you possibly can in the direction referred to above.

In my opinion, this is no time for important business men in this State to refuse to co operate in trying to save an industry that means so much good to the State and Nation and which, as a matter of fact, laid the foundation for the wealth of our great State, and that foundation was the "yellow metal".

San Francisco, February 1.

W. J. LORING.

[This letter was not intended for publication, but it is published by Mr. Loring's permission, at our request.—
EDITOR.]

Producer-Gas

The Editor:

Sir—In your issue of January 8 of this year, I note a letter by Mr. M. W. von Bernewitz on the subject of producer-gas, and, as this subject has received a great deal of my attention for the past fifteen years, perhaps additional light on the subject may be of interest.

Mr. von Bernewitz's statement that the number of producer plants in this country is small as compared with the European field, leads one to the impression that the state of the art in this country is behind that of European factories. The real reasons that influence the very slight progress in producer work in this country are, first, abundance of cheap coal suitable for steam purposes, and, second, the high cost of labor. In Europe, conditions are exactly the reverse. There we find an abundance of cheap labor, while the price of coal is at a high figure. In the course of my work, I have had occasion to operate European producers, such as the Mond, Koerting, Crossley, etc., in this country, and I have found, without an exception, that they have made a poor showing as compared to our native product, this being entirely due to the fact that they are not designed to operate on what we consider low-grade fuels. By low-grade fuels, I am referring only to fuels that are considered of low grade in gas-producer practice, which take into account neither the heat-units nor the market-value but entail such things as caking, fusible ash, high percentage of non-condensable tar, and also structural differences that interfere with the operation of gas-making.

While it is undoubtedly true that in Europe gas-producers are operating successfully on so-called low-grade fuel, these low-grade fuels are practically free from the elements referred to, it being far more important in gas to have a free-burning non-caking fuel than to have one high in heat-units. For example, I have operated

successfully a plant on No. 1 Buckwheat coal, averaging 18% ash, for 24 hours per day, for 11 consecutive years, the sole shut-down during that period being for a new set of brick linings. On the other hand, the endeavor to operate on our caking bituminous fuel, has invariably resulted in unsatisfactory performances. A large measure of the success in Europe is due to the fact that a careful selection is made of the fuel so as to segregate those suitable in character, regardless of the price, for gas-making; and once a plant has shown successful operation on a particular fuel or mixture of fuels, henceforth that exact combination of fuel is carefully provided for.

While it is true that a gas-producer can handle almost any combustible and make gas therefrom, it is also true that only certain fuels, having the proper characteristics, are found capable of manufacturing a uniform yield of gas such as required for the operation of gas-engines. Just as long as conditions exist in this country whereby it costs so much more to select, size, and grade our fuels, especially for a given plant, a practice due to high-labor costs and the type of available labor for the operation of plants which is at the present time of the lowest possible order, so long will it be impossible for this country to produce a showing in any way comparable to European practice, as to volume.

On the other hand, it is interesting to note that many plants in United States are operated on fuel that could not be handled by any of the European producers. The high percentage of fusible ash in our American anthracite makes it necessary to rate down the size of producers to keep the coal between 8 and 10 lb. of coal per square foot of grate-surface per hour, whereas with Welsh anthracite, 30 lb. per hour can be successfully gasified; and it was due to this large variation in capacity and to the fact that all the European producers shipped to this country failed to develop the rated capacity, that the producer business was given a black eye at its inception, inasmuch as the first plants installed were of foreign make. Any one of these errors as to ratings of European producers would be disastrous to the trade in this country, but the condition was further aggravated by the American manufacturing companies' total ignorance of the business, following blindly the dimensions taken from European practice.

Finally, in addition to the above-mentioned handicaps, the horse-power installation costs of gas-engines compares so unfavorably with the price of steam-engines, that manufacturers do not care to entertain the additional investment of a gas plant, even in the face of the possible economy obtainable thereby.

European gas-producers are undoubtedly to be congratulated on the feats they have performed with their plants, but they are by no means as remarkable as would be imagined from records that have reached this country. For example, the central station at Tours, France, which is reputed to be operating on saw-mill refuse, was found when inspected by myself, to consist of five producer-gas units, three of which were operating on saw-dust and small wood and the other two on high-grade anthracite.

The great variation in the quality of the gas made from the wood refuse was compensated by the fact that this gas went into a holder also supplied by the uniform gas generated from the anthracite plant, hence the resultant variation was within reasonable limits and enabled the operation of the plant. The amount of apparatus and equipment necessary to supply the gas at this plant, however, was fully three times as large and elaborate as would be considered by American industry, the producer-room being 165 ft. long by 60 ft. wide, all of which space was occupied by the producers, purifiers, scrubbers, etc., while the resultant horse-power generated was about 500.

This may be compared to an American manufacturing plant, the Horton Ice-Cream plant in New York, which had a producer-room 25 ft. by 30 ft., containing 750-hp. producers, which pulled a continuous load 24 hours per day, and there being no gas-holders to relieve the situation and to take care of any variation in quality of gas. Nevertheless, even with this rather remarkable showing, it is doubtful whether the owners of this plant would purchase a second gas-engine installation inasmuch as the labor charges and investment costs are so high compared with what could be obtained from a steam installation, equipped with automatic stokers, etc.

Generally speaking, therefore, it is not the difference in the state of the art in Europe and the United States that accounts for the comparatively small installation of gas plants in this country, but the difference can be ascribed to the high labor-costs and low fuel-costs, which to a large measure remove the incentive for using this type of installation.

GODFREY M. S. TAIT.

Washington, January 27.

An International Association of Silver-Producers

The Editor:

Sir—Since the publication of my former communication, in your issue of December 18, that of Mr. Hugo W. Miller has appeared in the issue of January 8, and it seems that I have not been completely understood. An international association of silver-producers would not have the object expressed by Mr. Charles Butters, in your issue of May 31. Mr. Butters, it will be remembered, wished to have silver coins brought into general circulation in the United States, instead of paper.

My suggestion was not intended to apply to operators in the United States, as for the present these are quite contented, but to those in other countries, mainly Mexico and Canada. Nor can we think that an association of silver-producers would for one moment consider the possibility of introducing bi-metallic standards, as suggested by Mr. Miller. With the silver-producers the present is no time for the re-consideration of momentous political schemes, even if there were a chance of carrying them out. The producers, other than those of the United States, are in a sad plight, and all they wish is to get out of it.

The bad effect of fluctuations in the price of silver is

seen in India, by the growing preference for gold in place of silver. Such a preference formerly grew in Europe until the more valuable standard replaced the less valuable, the bi-metallic period being one of transition only.

It is perhaps not necessary to again state the most important part the producer should take in stabilizing the price of silver, but the possibility of his efforts in other directions may be considered. The history of silver shows that aggressive action on the part of the producer can materially increase the amount of this metal employed as a circulating medium. In the 16th century the silver of a rich mine at Joachimsthal, Bohemia, was mined by the owners into a coin, known as a 'Joachimsthaler', so as to pay wages and other mining expenses. The coin began to circulate freely in the surrounding German countries and its name was shortened to 'thaler', from which comes the English word 'dollar'. For similar reasons, Spanish coins made of Mexican silver were later put into circulation, and at one time were even recognized as common currency in England and all western Europe, as well as in the Americas, being commonly referred to in the English language as 'dollars'. Still later the Mexican trade dollar invaded the Orient. The process was automatic, because the governments concerned made good profits in coining the silver, even as the Mexican government is now doing.

The ultimate consequence of the present large-scale coinage of Mexican pesos will be the practical elimination of gold from Mexican currency (by Gresham's law). This, in turn, will affect the premium on gold in Mexico, so that gold mining will be benefited as well as silver mining. A still further coinage of the new peso would not so easily find its own way to Oriental countries, because Mexico is not now, as formerly, in the route of travel between Europe and the Orient. The migration could be facilitated, however, by an international association. The result would be better if the producers were to have a coin struck, similar in size and general appearance to the Mexican trade dollar, but having its name and silver content stamped on it in various languages. The Mexican trade dollar fixed the standard unit of silver coinage for several Oriental countries, and such a coin has easy access to commercial use.

One must not overlook the fact that Russia, Siberia, and other countries are overdoing the issue of paper money, and if silver is made available in quantity, by a proper organization, it might now be acceptable by those who have raw material for sale, and therefore by those commercial firms or associations who make trade with Russia their business.

What Mr. Butters says about silver advertising itself is very important, but one should popularize it in those parts of the world where there is reason for its demand, that is to say, where there is not confidence in a government's ability and good faith to redeem its paper. One may imagine that if the owners of the Joachimsthal mine had depended on the sale of silver bars, as we do now, they might have had to produce on a very limited scale. So might the Spaniards and later the Mexicans. Some-

one had to take the initiative and put silver in convenient form for circulation, then offering it for commodities to traders with a country where there is a lack of stable money.

BLAMEY STEVENS.

Triunfo, Baja California, Mexico, January 25.

Mining Engineers and the Institute

The Editor:

Sir—In your issue of January 15, in an editorial on Mr. Washington Vanderlip, you make the assertion that all mining engineers worthy of consideration belong to the Institute of Mining and Metallurgical Engineers. Those few who don't, you say, have some personal grievance against the honorable secretary or are simply cranks. Such a statement reminds me of the talk of a machinery salesman who implies magnificently, in his effort to impress you, that "of course everyone of any consequence uses our product".

As a matter of fact, I know dozens of mining engineers, of all degrees of importance, who do not belong to the Institute, and see no reason why they should join that body any more than they should join the Elks, or the Red Men, or the bald-headed league. Many mining engineers get enough technical reading-matter by subscribing to either or both of the mining engineering weeklies, and do not find the publications of the Institute especially interesting. The local meetings of the Institute are, of course, worth attending in some parts of the country, but in other parts, for various reasons, they are not.

The point I wish to make is that there are excellent reasons for many reputable mining engineers not being members of the Institute, and some of them, as Mr. Shockley suggested, have a considerable knowledge of mining.

P. B. McDONALD.

New York University, January 20.

THE currency throughout Chinese-controlled Manchuria, according to a consular report, is in the same unsatisfactory condition as in other parts of China, there being no standard coin nor any fixed rate between numerous moneys current. The value of each is determined from day to day according to credit of issuer, denomination, or the demand for it in the market. The ruble has depreciated the most, the Japanese yen alone maintaining really sound value. Currency of the following equivalent is negotiable: (1) Chinese currency—such silver as the sycee, one dollar, and subsidiary coins; copper in old cash, one-fiftieth and one one-hundredth of one-dollar coins; notes issued against new silver coins and old copper cash. (2) Of foreign currency—such silver as the old Japanese yen, Japanese subsidiary coins, Russian subsidiary coins, Hongkong dollar, and Mexican dollar; notes issued against such currency, consisting of silver-standard notes from the Yokohama Specie Bank and various foreign banks of Tientsin and Shanghai; gold-standard notes from the Bank of Chosen and Bank of Japan; and in normal times the Russian ruble notes.



A 250-KW. GENERATOR, WEIGHING FIVE TONS, AT THE TOP OF A MOUNTAIN, READY TO START DOWN

Packing for Export

By C. M. Eye

INTRODUCTION.—A local firm, advertisers in the 'Mining and Scientific Press', heads a recent circular on this subject with the statement: "We Know How to Pack for Export", and follows this with a quotation from the 'Literary Digest':

"In the last few years, the increased cost and shortage of proper wrapping and packing materials have induced many shippers to adopt a policy of unwise economy, whereby they use inferior packing not sufficiently substantial to withstand ordinary handling in travel."

Now, I am convinced that this firm, in common with many exporters in San Francisco, does know how to pack for export, and does pack as carefully as possible. In

consequence, they suffer very few breakages or losses, either in ocean transit or in delivery to the final destination, which may be some remote point in South America, in the interior of China, or in the Philippines. In order to ensure such safe delivery, not only is it necessary to observe certain well-developed rules having to do with the safe handling and storage of goods in the holds of ships (for most goods exported from here begin the journey by boat), but the conditions under which delivery is made in the foreign country must be known and met in due course.

Now, I am not posing as an expert in the art of packing, but I have received many thousands of dollars' worth



—AND ITS ARRIVAL AT THE BOTTOM, TWO DAYS LATER

of goods in localities many thousands of miles from here, and so I have had a chance to see the results of both good and bad packing. The proof of the pudding is in the eating, and I wish to say that it leaves a bitter taste to have some article, for which one has waited a long time and which is essential, either broken or missing because of lack of care in the original packing, or to receive a package of goods that has to be unpacked at sea-board and subjected to risks of breakage or loss of parts, because it is too large or too heavy to handle with the means at hand.

It is the business of the consignee, of course, to supply the necessary information as to how the goods are to be handled after landing, stating the allowable limits of weight and dimensions of any given package, the extent to which goods are to be protected from moisture, with full instructions as to marking, billing, etc. Then it is up to the exporter to comply with these limitations and instructions. Local conditions vary so greatly in different parts of the world that it is difficult to generalize, but the conditions governing shipment by sea are pretty well standardized. Let us try to follow the process through from start to finish:

SHAPE OF PACKAGE. There is no doubt that where conditions permit, the rectangular package (box or crate) best fits ocean shipment, and, as a rule, local conditions at the other end of the journey. During the War, the congestion and the lack of space led to the substitution of boxes for barrels. This not only economized space and saved money for the consignee by cutting down the cubic measurement for a given quantity of goods (for, as everybody should know, most ocean shipments are figured in the so-called cubic ton of 40 cu. ft. or the metric equivalent), but in most cases the change was also welcomed on account of the more convenient handling of boxes for local transportation. It seems to me that the use of barrels is only justified, outside the shipment of oils and other liquids, when some fragile article, such as a graphite crucible of cylindrical shape, is to be shipped separately. I want to say here that, in my opinion, graphite crucibles in any but the smaller sizes should always be packed individually. The practice, in which some manufacturers of crucibles still persist, of packing in hogsheads, not only gives the consignee an unwieldy package to handle, but often results in chipping and breakage.

The shape of the package necessarily must conform to the shape of the article or articles contained, as, for instance, shafting will require boxing the interior dimensions of which equal the exterior dimensions of the shaft. I think that shafting should always be boxed, after receiving a protective coat of paint, and if it is in sizes from two inches down, it is better to include several lengths in the same box rather than to make separate packages. Where conditions permit, the nearer a box comes to being a cube, the better, for several reasons.

SIZE OF PACKAGES. This should be governed more by the stated requirements for economical transport than by any other consideration, but, aside from these, uniformity and compactness are important. The ideal ship-

ment is one in which all the packages can be of the same size and form, as, for instance, borax glass or evaporated milk. Shipments of machinery or of mixed supplies cannot have this uniformity, however, and in such cases it must be left to the shipper to determine the best form and size. It is better to ship machinery 'knocked down' as much as possible, for safety as well as for convenience in handling.

WEIGHT. The foregoing paragraph applies here also, with the added remark that weight cuts a greater figure in the matter of convenient handling than does the size or form of a package. I should say that weights from 50 to 150 lb. are the most convenient for meeting general conditions, 100 lb. being the ideal weight because it is within the capacity of one man's handling. The cost of moving packages increases rapidly with any increase in the number of men required to perform the operation.

CHARACTER OF MATERIAL. Excelsior is no doubt the best material for filling, and the most generally used. If the article is fragile, it should first be wrapped in soft paper, and if a number of such articles of similar shape are nested, each must be wrapped separately, so as to prevent contact. If it is of such a nature that it may be injured by moisture, it must be wrapped with water-proof material, or, better, if of metal subject to corrosion, it should be given a coat of grease. When shipping delicate machinery or apparatus, it is a wise precaution to line the case with tar-paper, or other waterproofing.

Sawdust, straw, and paper are poor materials for filling. The first because it will run out if the package is broken, and if exposed to wet it becomes soaked, causing corrosion, due to the organic acids it contains. The second will become moldy and will cause heat and possible combustion if wet. The third is unsatisfactory because, if crumpled, paper does not hold the included articles in place; while if used flat it adds too much to the weight. This does not refer, of course, to the use of corrugated cardboard, which, when the conditions warrant the added expense, is one of the best of filling materials; it is particularly adapted to use in sending small packages by parcels post. This and similar materials may be regarded as special, however.

As to the choice of material for the construction of the container, there is frequently but little opportunity to choose, but when there is, the best is none too good. The best may not be the most expensive; for instance, in the choice of timber, from which most boxes are made, one that combines strength with lightness and freedom from splitting is the best. It is probable that spruce combines these qualities more than any other wood, with white pine as second choice and Oregon pine as a close third. Redwood, while light and free from the tendency to split, is not strong, and, besides, is usually too expensive.

I am not going into the matter of how to build a container, for the professional packers employed by our exporting firms know how to build and reinforce a box far better than I do, but I want to say that all packages for export should be well and tightly bound with strap-iron before shipment. Twisted wire binding is even bet-

ter, for it is not so apt to rust through, and is cheaper than strap-iron of equal strength. Some exporters make the mistake of using strap-iron that is too light, with the result that the case arrives with the binding either rusted through or broken in handling. Another advantage of wire over strap-iron for this purpose is that it is more difficult to tamper with a package. This is often an im-



AN EXAMPLE OF GOOD PACKING AND GOOD MARKING

portant consideration in places where light-fingered gentry abound.

QUANTITY OF PACKING MATERIAL. Use plenty, but not too much. Sage advice, you will say. How much is plenty depends entirely on what you are shipping. For instance, pipe, bar-iron, stamp-shoes and dies require little or none at all, while a surveying instrument or an analytical-balance will require a great deal. I will say, however, that in general when shipping heavy supplies or machinery to foreign countries, it is better to err on the side of too much than too little packing material. As a rule, the ends of packing-cases for heavy goods should be of two-inch, and the sides of one-inch, lumber. If the ends are of one-inch, they must be reinforced around the edges with one-inch material for proper nailing and for strength. When there is any doubt as to strength, it will pay to use two-inch material forthwith. Frequently it pays to salvage material at the point of delivery, where labor is cheap, and it is well known that more can be salvaged from two-inch than from one, so that the expense due to the added weight, size, and quantity of lumber may not be a dead loss.

DISPOSITION OF GOODS IN PACKAGES. I believe it axiomatic that no two decidedly different classes of goods should go into the same package if it can be avoided, especially if one is heavy and another light. If it be necessary to pack more than one piece or package of the same kind or similar in weight, they should have filling interposed, and if a heavy piece has to be included, it should be well secured from shifting. When several castings are placed in the same box or crate, as is sometimes advisable, each must be secured in place, to prevent shift-

ing and breakage. I consider it a mistake to put two pieces of finished machinery in one box, for the results are too serious in the event of one or the other breaking loose. Machinery, after stripping and packing separately down to the main frame, should always be bolted to strong stringers which later can be used as skids, the bolts, of course, going through the bed-plate holes, with the heads, supported by washers, in counter-sunk recesses below. The floor beneath the stringers is usually made heavier than the sides and forms the base on which sufficient boxing and crating is built, to protect the machine. This usually can be quite light, and should preferably have openings in the sides, to render it more likely that it will be kept "right side up with care". The superstructure must be built sufficiently strong, however, to stand having other heavy packages piled on it in the hold of a ship, for it is here, and in loading and unloading, that more breakages occur than at any other point. All babbitted bearings must be specially protected from injury and all cut gears and other finished surfaces should be painted or greased.

Pulleys and gears are probably more subject to breakage on a journey than any other line of machinery. As these are expensive and so very important to operation, I wish to devote some space especially to the packing of these parts of machinery.

Each pulley or gear should be packed in a separate case or crate, unless there are a number of the same diameter,



A SHIPMENT OF LABORATORY APPARATUS FOR EXPORT
Photograph by courtesy of Braun-Knecht-Heimann-Co., San Francisco

when they can be packed together to advantage. Each case should be square, with internal dimensions equal to the outside diameter of the pulley or gear and the face thereof in thickness, to ensure a snug fit. If there are keys or set-screws, these should be wrapped securely, and wired to a spoke or to the hub. If the pulley or gear is fairly heavy, the enclosing square should be of two-inch lumber, and, if very heavy, the sides also. Ordinarily, however, the sides can be of one-inch stuff, with safety. The sides need not necessarily be closely boarded, but better protection is afforded at little additional cost by haying them so. There should in no case be blocking or filling

of any kind within the case, as this may easily be the cause of breakage, in case weight comes on the side of the case, as frequently happens in the hold of a ship. Any such pressure transmitted to the hub or spokes is likely to cause damage, for the pulley or gear then becomes a beam supported at the ends and loaded in the middle. Pulleys and gears are not built to stand a transverse strain of this kind. This applies especially to a pulley or gear in which the length of the hub exceeds the width of the face, for then the side pressure comes directly on the hub. No harm ordinarily results from this, however, if the spokes and rim are left free, for the pulley or gear is free to move as a whole, and the sides of the box would have to be broken before damage could ensue. No piece of machinery should ever be shipped with the pulleys or gears in place, if it is practicable to remove them for separate packing.

MARKING. Each separate piece of goods for export should be marked plainly with the name and mark (if any) of the consignee, the name of the shipper, the destination of the shipment, the weight and dimensions of the package, and the net weight of the same, as well as the serial number corresponding to the shipping manifest. A copy of the packing-list should be included in each case, or attached to each bundle. The marks, preferably stencilled, should be made with paint that will withstand moisture and that will not rub off. The attaching of tags to bundles is a mistake. Iron or steel bars or pipe that do not require crating should be made up into bundles of convenient size, well secured by wire or iron clamps, and each bundle should be plainly marked with white paint. There are hundreds of plates or bars of steel or lengths of pipe kicking around customs-houses in various parts of the world because of failure to take these precautions.

I shall not attempt to go into the details of the checking of goods, for that is a story in itself, with which every exporter should be familiar. Suffice it to say that every lot of goods should be double-checked by responsible and capable persons, and that the greatest care must be taken in having the manifest agree with the checked list, to avoid subsequent trouble for all concerned.

In closing this article I shall recount an experience that illustrates how much trouble, expense, and delay can be caused by a shipper disregarding the instructions of a customer. In 1919 a 250-kw. generator, the arrival of which had been awaited anxiously for some time, was received at Manila by the company with which I was connected. Despite definite requests that this be shipped in two or more packages, it arrived in one, which was as large as a shack and weighed over five metric tons. It was considered risky to attempt to take it down and re-pack the rotor and stator separately, and it was necessary to get it to its final destination as quickly as possible on account of the approaching rainy season and because it was badly needed.

The transfer involved shipment by rail for 150 miles, haulage by wagon 35 miles from tidewater to an altitude of 5000 ft. above sea-level, unloading and transfer on

planks up-hill for two miles over a temporary road of about 8% grade, then sliding it down a steep ridge for another mile to the power-house. At the railroad the housing was all removed, leaving the skids and floor, and the generator was well wrapped with canvas and water-proof material, for the rains were already beginning. It was then loaded on an Army wagon, which fortunately was available, and the first lap of six miles or so was made by towing with a 1½-ton truck. This brought it to the foot of the grade, where a road-roller was attached and the rest of the journey was made in this way. Progress was slow but sure, and the trip was completed in ten days. It was then unloaded and transferred to the highest point above the power-house, this being accomplished by using snubbing-posts, block-and-tackle, and planks, the pulling being done with the truck mentioned, working down-hill on the fall-line of the tackle. Then came the real task, that of sliding a five-ton piece of machinery down a grade that in places was as steep as 45°. In two days more, however, it was safely landed at the bottom, with the aid of about 60 natives; and every one connected with the affair felt free once more to take a full breath. How much of trouble could have been saved us, had the shippers regarded our instructions. Remember, the man on the ground usually knows conditions and knows what he wants better than anyone else possibly can know. An observance of his requests is likely to lead to repeat orders.

A CONSERVATIVE estimate of the available potential water-power in the United States is 60,000,000 hp. Segregated according to States, we find that the State of Washington stands first with 9,500,000 hp. or 15% of the total potential water-power in the United States. California stands second with 9,250,000 hp. or 14.6% of the total, and Oregon ranks third with 7,000,000 hp. or 11% of the total. These three Pacific Coast States together represent 40.6% of the total potential horse-power of the United States. Including with these the States of Idaho and Montana, we find that the five Western States alone have a total of 35,750,000 hp. or 57.1% of the total potential water-power of the United States. Of this available power, only a comparatively small percentage of the total has thus far been developed. Of the 60,000,000 hp. of the United States only 15% has been developed. In California only 10.2% of the 9,250,000 available or 942,000 hp. is being utilized. In Washington the rate of developed to potential power is even less, being only 3.8%, while in Oregon it is only 3.5%. Comparing these with other sections having lesser amounts, we find that in the New England States 77.2% of the available water-power has been developed. It is a significant fact that while we have, west of the Rocky Mountains, only approximately 8% of the population of the United States, yet we have 68% of all of the available water-power. The Western States as a whole stand first in their per capita consumption of electricity, the use in this territory being 2.2 times as great as the usage in the remainder of the United States.

Organic Troubles

By Charles T. Hutchinson

Cadmus, the Phoenicians, or whoever it may have been that invented books, and, *ergo*, was responsible for the printed word as a means of transmitting and preserving thought, certainly started something. Had the starter realized that he or they would be held primarily responsible for what is known as the house-organ, they would have thought at least twice before inflicting this dire pestilence upon a world already fed up with a sufficiency of troubles.

Organs, of a kind, like the poor, are always with us, and always will be. With organs of the pipe variety, we have no immediate concern, nor shall we deal with reed organs. Rather it is organs intended to be read that we purpose presently to dissect, analyze, and otherwise reveal in their true colors. Organic troubles have fastened themselves upon the body economic. The world is simply plastered with organs, some of them monthly and many of them weakly if not actually poorly. Organs have become almost epidemic in business circles, greatly to the congestion of waste-baskets, ash-cans, and refuse-heaps.

When Moses slid down Mt. Sinai, and sold to the Israelites that famous group of slogans now nationally known as the Ten Commandments, he employed no advance agent, nor did he patronize billboards, subway-cards, or sandwich-men. The mouth-organ did the trick, his own mouth through which was emitted so effective a sales talk, that he put them over at a single sitting.

It was no cinch in those days. No man's voice had a national circulation, and there was no Associated Press whereby the dictum of Moses or any other alleged prophet could be transmitted rapidly to every household. Now that civilization, so-called, has achieved a lot of complexities equaled if not exceeded by its physical as well as mental growth, the human voice as an advertising medium is a back number without the assistance of the telegraph, the telephone, and the printed word. We poor humans, who love to talk about ourselves to the exclusion of all other subjects, were fast becoming limited to those of our friends whom we could button-hole in their unguarded moments, and even they were getting increasingly wary and difficult of access. So, what was to be done? Advertise ourselves we must, come what may, for otherwise who should know how great we are, we admit that we are, unless we could stress the first person singular, and show conclusively that the human biped is not merely two-eyed but Argus I'd.

Sound travels at the rate of 1090 feet per second, so the physicist tells us, but, when the space to be compassed is considered, the range of the *vox humana* is inconsiderable, and certainly falls far short of gratifying the insatiable thirst for the limelight that demands an audience without limit.

Little by little, during the countless ages, the ingenuity

of man evolved merrily through the transition from the hieroglyph and the parchment to the first printing-press with its crude hand-carved wooden type to the present day when the devilish ingenuity of Mergenthaler joins hands with the massive cylinder presses of Miehle: so that, in spite of Mr. Burleson with his hazards and bunkers in the form of zone postal-rates for second-class matter, it is possible for one man, or a group of men to exploit themselves to the suffering proletarians, in number limited only by the size of the purse of the propagandist.

That venerable document, the Declaration of Independence, guarantees to all of us the right to the pursuit of happiness. Therefore, when man has complied with the Freudian principle of satisfying his hunger, and acquiring a wife, the very next step in this never-ending pursuit is the exaltation of his ego.

Many and devious are the ways employed in this most absorbing of all occupations. The stage beauty, who immersed her pulchritudinous form within a bath-tub full of milk, and trusting in its protecting opacity, admitted a flock of newspaper reporters, differs merely in method from the public man who employs a press-agent to issue bulletins about him at regular intervals, or the manufacturer who causes to be printed an alleged 'journal' full of what is commonly known as 'bull', about himself and what he has for sale.

There are degrees in all things, and house-organs are no exception to this rule. Some of them are good, even excellent, and in point of real information compare favorably with the real honest-to-goodness publications that are sold on their merits and cannot be obtained in any other way. However, the pill is really there under the coating of sugar, however sweet or thick it may be, and the recipient knows it is a pill too, and in consequence is becoming more and more wary as he gains experience in the ways of the house-organist.

The time was, some years ago, when, in search of ways and means for exalting his ego, the egotist was content with the opportunities afforded by the public press as it then was, and, beyond the hiring of a press-agent to disseminate alleged 'news' items among the various publications, no individual effort was necessary. Now, alas, all is changed. Those good old times have gone, never to return. The editors, to say nothing of the business managers in charge of the affairs of the press, suddenly awoke to the fact that they were giving away a commodity that had a market-value. Worse than that, even where they were willing to sell space, they insisted that it be plainly labeled 'advertisement', which, of course, killed the effect that the self-seeker was after.

Thus, the editor has become a lynx-eyed cold-hearted person, with an uncanny faculty for smoking the Ethiopian from the press-agent's woodpile, however cunning-

ly be ready to concede them. As the strings became tighter, there was developed a corresponding skill on the part of the seeker for publicity, and, occasionally a story gets by the editor that turns out to be nothing more than the usual wolf in sheep's clothing. These occurrences are rare, however. The bars are up, and permanently, and no charter member of the Capital I Society can rest content with the meagre opportunities afforded him by the press as a whole.

What was to be done? Answer: the house-organ, a personally conducted and personally controlled publication, whereby old man Capital I himself can root for himself until the cows come home, and without restriction in any way, other than the size of his purse.

Thus came into being the house-organ, and their number has waxed apace until now they are as many as the sands of the sea. Of course, they are distributed gratis, for who would buy them? No man is immune from their onslaught, for in this great and glorious free country of ours anyone can mail to anybody else as much trash as he pleases, provided that such matter be not libelous, and conforms to our liberal postal regulations. That the individual involuntary recipient of the house-organ has learned to detect such things almost instantly, and has acquired a remarkable degree of skill as a marksman through his ability to chuck them into the waste-basket from ten to twenty yards, is regarded as a thing of small consequence by the house-organist. There is a chance, always a chance, that the victim may at some time unwittingly be cozened into perusing its pages before he detects the hook on which the delectable worm has been impaled. The fact that the reaction from this discovery is not quite what the house-organist would desire is subordinated to the fever of the chase, with the huntsman never losing hope that ultimately he may close with his quarry and deposit it in his game-bag.

As the house-organ idea developed, the more intelligent organist began to acquire a certain fundamental knowledge of journalism, principally that in order to be effective the organ must be read, and that to be read it must be interesting. So many of the better house-organs are cultivating the reader's interest by using the soft pedal a little more when they pull out the self-interest stop, and otherwise seeking to cloak the journalistic free-booter so attractively as to disguise as much as possible its real purpose. This added to the expense of publication, so much so in fact that many of the better and too many of the worse house-organs began the solicitation of paid advertising by reason of the large distribution, not circulation, that they had to offer.

On any logical basis, this plan is difficult of execution. The buyer of advertising space has learned how to appraise its value by years of painstaking study and experience, and has developed certain criteria that have become axiomatic. The most important of these is that only paid circulation is of any consequence. Consequently, on its merits, the free distribution of the house-organ should automatically estop it from any considera-

tion whatever. But, alas, man works in devious ways his purpose to put over, so a new angle was devised to get advertising for the house-organ, and, unfortunately, it works to a certain extent.

Many big corporations, and other organizations about which more later, have become the champion house-organists. They, in turn, are not merely sellers, but buyers of quantities of raw materials and certain finished products. How simple it is for the advertising solicitor to obtain from the purchasing agent a list of all those from whom the house-organist buys, and, armed with this potent ammunition, seek them out one by one, gently conveying the impression that an advertisement in the company's house-organ would do no harm, while not supporting the enterprise of their valued customer might make a most disagreeable impression upon the purchasing agent when they, in turn, sought business patronage. A hold-up? of course it is, and almost at the point of a gun too, but nevertheless it is done every day, and unfortunately it is a growing evil that ought to be vigorously stamped out.

Whether those in authority knowingly connive at such methods may be questioned, but feebly. No alibi, however specious and plausible, can absolve the bosses themselves from what is done by their hired men. The victims in most part give up their money with a shrug of the shoulders, and say, with an air of resignation, "You see how it is. How can I help myself? I can't afford to jeopardize my standing with them. They are one of my best customers, and, if they take this method of getting part of my profit away from me, I have to add it to my overhead charges and let it go at that."

Associations, both trade and, alas, professional, have become eager seekers for a share of this easy money. Nowadays no co-operative association of similar business interests seems complete without its house-organ. It is not difficult to sell the house-organ idea to a co-operative association, with so many apparently prosperous similar enterprises springing up like weeds all around them. The eternal ego in all men is the real reason behind their easy compliance, backed by promises of distribution only limited by the size of the war-chest, and the absence of the restraints placed by legitimate publications that must and will protect their readers.

If the truth were known, much of this apparent prosperity is nothing but a sham. In the great majority of cases, the house-organ is far from self-supporting; in fact, most of them would succumb at once, if the subsidy from those most interested were to be withdrawn. They are little else but a bit of flotsam tossed about by the tide of business, pandering to the vanity of the house-organists themselves, the red-ink balance at the end of the year being accepted with the same philosophy as the large donation to charity, provided that a gratifying amount of personal publicity accompanies it.

Even the professional organizations seem to have succumbed to the temptation. Their case differs somewhat from those of avowedly commercial organizations whose obvious purpose is money-making, and, by the same

token, there is less excuse for them. Members of an engineering society pay dues for two reasons, one of which is for the prestige which membership gives them, and the other for the Transactions. The latter, if carefully selected and edited, constitute a valuable reference library in the practice of their profession. For these two considerations, they pay about \$15 per year, or three times the cost of a first-class technical periodical.

What inspired the professional societies to enter the house-organ field is a nice question; as a matter of fact, there are still one or two of them who are maintaining their obligation to their membership by sticking to their original purpose, variously expressed in their constitutions as the "advancement of science". With some of the others it has been the retreat of science, and the advancement of something else, whatever it may be. From the dignified, orderly Transactions, with their carefully selected professional papers, there has come a journal of sorts, filled with the gossip centring about headquarters activities, in which a ridiculously small proportion of the membership can participate, a number of accounts of the peregrinations of various officials, the trips they took, the banquets they attended, and the speeches they made, and other padding generally called 'Society News', and, perhaps, a perfunctory digest of technology from current periodicals and even an article or two of more or less interest. It is thin, even anæmic, and, this should be whispered, little other than a vehicle for such advertising as the proponents of the house-organ idea have succeeded in cajoling manufacturers into taking.

The line of attack in soliciting differs in some respects from that pursued by the other house-organs. There is first the plea of the high professional character of the membership, without, of course, explaining that the house-organ is forced down the throat of the membership, who put up with it for the sake of the Transactions that appear yearly. If that fails, there is the sympathy dodge, "Friend, feed me lest I starve" idea, where the advertising is solicited frankly as a donation to a worthy cause. Then, last but not least, there is the threat, real or implied, that the engineer is apt to be more friendly in his purchases to those who use the advertising section of the journal than to those who withhold their patronage.

Really, in the final analysis, it is all one and the same thing. In mathematics, the thing is to state correctly the hypothesis. In publishing or other aims in life, it remains to discover the motive. Since the imputation of motives is always a dangerous pastime, one may only theorize as to the real inward 'why' of it all. It would seem at least reasonable that the council, board of directors, or whatever they may be called, of the engineering society lately turned publisher, succumbed to the plea of possible profitable business with more money available for the expansion of the society's activities. The proponents of the idea, the paid secretarial staff of the society, saw, in the embarkation into a business enterprise, increased emoluments for themselves without the attendant risk associated with a business that must stand or fall upon its own merits.

The great lack in all such publications is the one thing without which outside advertising cannot be conscientiously solicited, and that is, reader interest. Reader interest can easily be claimed, and, of course, always is, by any advertising solicitor. Claims are one thing, however, and proof is another, and reader interest can be proved conclusively upon no other basis than the actual payment in cash by the subscriber for the publication. Free distribution is of little or no value to the advertiser; distribution of a publication to members of a society or association free, or in part consideration for dues or assessments, is little, if any, better; the only circulation that is, on the face of it, clearly and definitely valuable to an advertiser is that which is bought and paid for in cash by readers because they want it.

All of these things are clearly understood by the better advertising agencies, and by the Audit Bureau of Circulations, whose reports differentiate clearly between the many classes of publications upon this general basis. They are also understood by advertising managers for business enterprises, so, when considered upon their intrinsic value as advertising media for anyone other than the publisher, they would receive scant consideration. Therefore, the form of solicitation is generally that already referred to, and offers considerations that are little more than a jimmy with which to pry orders from the helpless buyer of space.

Again, publishing is a business, requiring skill, training, and experience. The pitfalls are many, and a group of doctors, dentists, engineers, or what-not, who blandly jump right into the middle of things and think because perhaps they have become passable doctors, dentists, or engineers, they would make regular prima-donna publishers, are apt to experience a jolt that will paralyze the pocket-nerve, or worse, the pocket-nerves of the individual members of the society or organization into whose treasury they have so gaily dipped in the quest of easy profits. There is one case of this kind already that will require a lot of explaining, as to the why's and wherefore's of more than double the annual dues in order to make up the deficit of the past year's experience in the publishing business.

Man, collectively and singly, is queer fish at best. It has been said that the only real difference between man and the lower animals is that between reason and instinct. Sometimes, however, one is inclined to be somewhat in doubt about the evidence of reason as exemplified by some of the things we do. We follow fads and fancies, just as surely as the sheep follow their leader, blindly, instinctively. House-organs have become epidemic, so instinctively.

House-organs have become epidemic, so what ho! let us have a house-organ. Everybody's doing it, and then everybody overdid it, and now, in the general process of deflation, the house-organ too, when subjected to the scrutiny of the microscope, stands before the real economist, naked if unashamed. The ash-cans are full of them, and, in fulfilling this function, the ash-can is one of the noblest works of man.

Consumption of Reagents Used in Flotation

By Thomas Varley

***INTRODUCTION.** In April 1919, as a result of many requests received from individuals and mining companies for such information, the U. S. Bureau of Mines sent to milling and ore-dressing plants a questionnaire asking for data on the tonnages treated both by gravity concentration and flotation, the tonnages of concentrate produced by each system of milling, and the consumption of oil, acid, and other reagents, as well as the kinds used, these returns to cover the calendar year 1919.

It was hoped to issue a report by mid-summer of 1920, but much delay was experienced in collecting the data. Some of the companies refused to give such information, although most of them made prompt and complete returns. However, replies have now been obtained from practically all plants, and the following statement has been prepared. The figures presented are representative and complete enough for all practical purposes.

The reports showed that there was 26,545,564 tons of ore of all kinds treated by flotation, from which 3,105,343 tons of concentrate was produced, showing a concentration ratio of 8.55:1.

The total amount of oil, acid, and other reagents used was 113,510,234 lb., equivalent to 4.2384 lb. per ton of ore treated. Of the total quantity of ore treated, by far the greater part was copper ore. Tabulations for the various ores are given in detail, showing a summation of all reports received.

GOLD-SILVER ORE. Not many reports were received from companies treating ores of gold and silver. In the plants making reply, there was treated 75,081 tons of ore, yielding 8698 tons of concentrate, a concentration of 8.63:1. Oils used were petroleum fuel-oil, 42,054 lb., pine-tar oil, 24,720 lb., and turpentine, 36,320 pounds.

GRAPHITE ORE. The number of tons of graphite ore treated was 55,980, yielding 906 tons of concentrate, a concentration of 6.18:1. Oils and reagents used were pine-oils, soda ash, and lime, aggregating 250,700 lb. in all.

MISCELLANEOUS ORES. This class includes ores of the rarer metals, such as molybdenum and antimony, and complex mixed ores of various kinds. There was treated 73,690 tons, yielding 5840 tons of concentrate, the ratio of concentration being 16.62:1. Oils and reagents used were sodium sulphide, 73,360 lb.; soda ash, 133,770 lb.; sodium silicate, 111,136 lb.; and pine-oils, 22,786 pounds.

COPPER ORES. In tabulating the returns for copper ores, all plants that were treating ore solely by gravitation methods have been excluded. Many companies, however, use a combination of gravity concentration and

flotation. Usually flotation supplements gravity concentration, although in a few plants the reverse was reported.

Of 38,255,707 tons of ore milled, 23,265,832 tons, or 60.8%, was treated by flotation. This would indicate that 39.2% was discarded as tailing low enough in metal content not to warrant re-grinding for further treatment, although a certain small proportion would represent concentrate removed by concentration machinery.

The total amount of oil, acid, alkaline reagents, and all other flotative reagents used averaged 4.6360 lb. per ton of copper ore treated. In the following table the total amount of each reagent used is also calculated as the average number of pounds consumed per ton of ore. This figure, of course, does not represent the average consumption in any one flotation plant, but nevertheless is of interest. Some plants use large quantities of one reagent, either oil, acid, or alkali, whereas another plant may not use any of the flotative reagents employed at the former plants.

It will also be noticed that the oils have been grouped somewhat under general headings. All the special brands of coal-tar have been grouped, also various brands of coal-tar creosote, hardwood creosote, pine-oil, pine-tar, etc.

The total amount of copper ore treated by flotation was 23,265,832 tons, producing 2,837,660 tons of concentrate, a concentration ratio of 8.23:1. The following table shows the kinds and amounts of oils and reagents used for this tonnage.

Reagent	Pounds	Equivalent in pounds per ton of ore treated
Coal-tars	20,488,275	0.8787
Coal-tar creosotes	1,399,170	0.0601
Hardwood creosotes	1,774,722	0.0767
Pine-oils	2,142,065	0.0920
Pine-tars	1,064,199	0.0498
Fuel-oil	212,985	0.0099
Sulphuric acid	70,290,505	3.0254
Caustic (kind not stated)	1,570,200	0.0675
Kerosene acid sludge	7,935,200	0.3402
X-cake	228,740	0.0099
Xilidine	188,472	0.0088
Turpentine	23,310	0.0009
Other oils	375,000	0.0161

Total average number of pounds of oils and other reagents used per ton of ore treated . . . 4.6360

LEAD AND LEAD-SILVER ORES. The tonnage of lead and lead-silver ores treated by flotation is considerably less than that of copper ores. This may be due to the fact that in the former, the valuable minerals are more concentrated than in copper ores, in which the mineral constituents are generally finely disseminated.

Flotation generally supplements gravity concentration,

*Published by courtesy of the U. S. Bureau of Mines. The author is metallurgist in charge of the Salt Lake City station.

and a large tonnage of material or tailing low in metal content can be discarded. This is especially true in the south-eastern Missouri lead district.

The returns show that the total quantity of these types of ores treated by combined gravity and flotation methods was 6,742,815 tons. Only 1,671,740 tons, or 24.78% of the total tonnage reported, was treated by flotation. This 1,671,740 tons re-treated by flotation produced 147,552 tons of concentrates, a concentration ratio of 11.33:1.

A list showing the oils and other reagents used for treating this tonnage, and the amounts consumed, follows:

Reagent	Pounds	Equivalent in pounds per ton of ore treated
Coal-tars	324,861	0.1943
Coal-tar creosotes	71,860	9.0430
Hardwood creosotes	642,051	0.3840
Pine-oils	221,416	0.1324
Pine-tars	22,904	0.0135
Wood-tars	86,926	0.0520
Crude petroleum	318,544	0.1905
Sodium sulphide	151,212	0.0904
Cresylic acid	12,069	0.0072
Sulphuric acid	98,027	0.0586
Kerosene	9,707	0.0057
Gasoline	2,934	0.0017
Soda ash	95,210	0.0570
Sodium silicate	144,371	0.0863
Nitre-cake	161,270	0.0964
Other reagents	86,720	0.0517

Total average quantity of oils and reagents used per ton of ore treated by flotation.....1.4647

ZINC ORES. The reports show that 2,917,443 tons of zinc ore was treated by combined gravity concentration and flotation, 1,563,482 tons or 53.59% of the total tonnage being treated by flotation alone. This yielded 211,302 tons of concentrate, a concentration ratio of 7.39:1. The oils and reagents and the amounts of each used for this tonnage follows:

Reagent	Pounds	Equivalent in pounds per ton of ore treated
Coal-tar creosotes	21,110	0.0013
Hardwood creosotes	31,742	0.0020
Copper sulphate	81,145	0.0518
Pine-oils	1,741,674	1.1136
Crude oils	11,238	0.0007
Other oils and reagents.....	63,300	0.0041

Average quantity of oils and reagents used per ton of ore treated2.5578

GENERAL REMARKS. The most generally used flotation reagents for copper ores are sulphuric acid, kerosene acid sludge, and the coal-tars. For lead and lead-silver ores, hardwood ereosote is used the most, followed by coal-tars, crude petroleum, and pine-oils in the order named.

Most important for zinc ores are the pine-oils, which constitute 43.5% of the total quantity of oils used for this ore, with copper sulphate and hardwood ereosote next in importance.

Among the other reagents used are such materials as

sulphur; specially prepared and fractionated oils, of coal-creosote, wood-creosote, and pine-oils; also various sodium salts, ammonia, and ammonium salts.

Low-Grade and Complex Ores in Colorado

It has been recognized that the metal-mining industry in Colorado has been on the wane for several years, mining now ranking fourth among the basic industries of the State. This marked decline of metal mining from its former supremacy is due partly to the unusually rapid growth of the other industries and partly to the decrease in mineral production both in quantity and value. With a view to aiding and encouraging metal mining a fund of \$15,000 was made available by the State for an investigation of the low-grade and complex ores of the State, to be undertaken jointly by the U. S. Bureau of Mines and the Colorado School of Mines. The object was to determine the character and approximate extent of these ores, and where found in sufficient quantity, to conduct concentration tests at the Golden laboratories in an effort to devise a cheap and suitable treatment.

The metallurgical work was under the direction of W. H. Coghill, metallurgist, assisted by C. O. Anderson, J. P. Bonardi, and Max Shapiro, of the Bureau of Mines, and J. C. Williams and E. V. Engels representing the State. The first step was to make a careful physical examination of the ore, followed by chemical analysis to determine the content and character of the minerals present. If this showed that the valuable minerals present were so intimately associated or 'locked' in the ore that they could not be readily separated, then methods of treatment were applied which experience had shown would be most likely to give the desired results. Twenty-nine of the ores submitted were examined and their amenability to concentration determined insofar as time permitted. The principal processes tried were flotation, gravity concentration, and cyanidation. The most promising results were obtained by using flotation combined with gravity concentration. Differential flotation, or flotation of one mineral in advance of another, to make a complete separation, is not applicable, except in rare instances, to Colorado complex ores. From the complex sulphide ores galena and the precious metals were recovered as far as possible by gravity concentration. To recover the finest grains of galena, the chalcopyrite and the remainder of the gold and silver, means had to be devised to float them in advance of the sphalerite. Sodium sulphide was found to be a valuable reagent in this step. Results in the laboratory tests with sodium sulphide, and with an acid solution of sodium dichromate to grade up the zinc by flotation, have been so successful that they should receive further attention. The principal function of the dichromate was to remove the iron sulphide from the zinc, but it also removed some of the lead, silver, and gold. The oxidized ores were tested principally by cyanidation, but some flotation tests were made. Some of the ores were readily amenable to cyanidation; but others proved refractory.

Karl Eilers v. Guggenheims

213 Broadway, New York City, January 31, 1921.

To the Stockholders of American Smelting & Refining Company.

Sirs:

Probably you have wondered at and perhaps been concerned about the situation in your Company.

Its stocks have declined far below those of other supposedly good industrials.

Its net earnings have declined so as to be changed into losses.

Its cash has declined so that the Company has become a large borrower.

Its directing head has declined and tapered down from a Daniel Guggenheim to a Simon Guggenheim.

Its organization has declined in morale, efficiency and personnel.

Its dividends have declined and its chances of increased dividends are steadily declining.

Its business prospects are declining, particularly since the recent gift of the copper sales agency (heretofore worth more than a million a year) to Guggenheim Brothers.

Why? Why?

Your Company should be managed by and for its owners—you stockholders—and not for any outside interest.

The Guggenheim family formerly owned a very large stock interest—probably the actual control. They absolutely dominated the Company.

When either because of or in spite of this domination the Company had grown and a broad market had been established for its stock, the Guggenheims quietly sold out "on the other stockholders" to the extent of practically all their stock. It then being to their interest, perhaps they really did do a good deal toward placing the Company in such good position—that they could profitably sell out. At any rate, up until after that time Mr. Daniel Guggenheim gave to the matter his personal attention.

Since then, taking their profits and investing them elsewhere, the Guggenheims have had larger financial interests in other concerns with interests conflicting more or less with those of your Company. However, they have held on to the control of your Company largely because of the prestige and strength it gave them in handling their own enterprises. They still absolutely dominate your Company because you stockholders have not awakened to the alarming situation which has been greatly intensified by these changes. That the Guggenheims themselves are quite awake to the change occasioned by their disposal of their stock interest is shown, perhaps, by the fact that, except in matters affecting Guggenheim interests, Mr. Daniel Guggenheim has ceased to bother with the affairs of your Company, and whatever vision and

direction it gets has to come from his younger brother, Simon.

They gave an illustration of their absolute domination and of their disregard of stockholders at the last election. They used the proxies, confidently sent them by the stockholders, to drop me from the Board (and they now speak of me as a discharged employee) although the Company's books show that I was by far the largest stockholder on the Board. I happened to be personally in a financial position which allowed me to question Simon Guggenheim's plans and policies when they were not in the interest of the stockholders, and often I had found it necessary to do so. The sole ground of my removal—obligingly given in advance in writing by President Simon—was that I was not in accord with him.

The Guggenheim management of Smelters has but just now transferred as a *gift* from your Company to Guggenheim Brothers contracts for copper sales agency or brokerage which brought the Company in net proceeds of over \$10,000,000 in eight years. No characterization of this amazing transaction is necessary. The Guggenheims, apparently, thought they had to say something and have sought to do two difficult, if not impossible, bits of explaining—that is, to justify this *gift* and to excuse certain past losses incurred in gambling in copper—by playing one questionable act off against another in making the absurd claim that the gambling was a necessary part of the brokerage.

Do you, an owner of Smelters, believe that the Guggenheims, who are but slightly interested in Smelters and very largely interested in Guggenheim Brothers, should have had the "say" as to handing over that valuable business? Should they have the say as to the making of smelting contracts with mining companies in which they are interested more largely than in Smelters?

Although in the *fourteen* years, ending June 30, 1920, the capitalization and debt of the company have been largely increased, no possible benefit therefrom has accrued to the stockholders. The net quick assets per \$100 of capitalization and debt show no increase. And on the contrary the dividends on the common stock have declined from $7\frac{1}{2}\%$ to 4% per annum.

The Guggenheims have resented criticism by the real owners and have run your Company, with which they are little concerned, as a convenient side enterprise of their own.

For instance, they have turned over to Smelters for approximately \$22,000,000 in cash and its equivalent some of their poorer mines. But by a remarkable series of coincidences neither Chile, nor Braden, nor Utah nor Nevada Con., nor any other of the wonderful successes offered to the Guggenheims ever found its way into Smelters or was offered to its stockholders, but went where the Guggenheims personally were more interested.

That is, Smelters paid them for less successful mines, but never even by accident did it get any of the remarkably good opportunities which came to the Guggenheims originally because of their positions in Smelters.

The domination of the Guggenheims is to be regretted not only for many things which they have done, but also for many things which they have not done, and even more for many things which, by merely occupying the positions of power and initiative, they have kept others from doing. Perhaps the greatest of all the evils due to their domination is that it has prevented, and, if continued, will prevent your Company from having a management of its own of responsibility and initiative.

To remedy this is of the utmost importance, and can be done, I believe, with very few changes in the management if the Directors are made to owe their position to the vote of the stockholders and not to the whims of the Guggenheim family. The removal of the Guggenheim threat with the opportunity of freedom of action to the Directors and management will immediately increase the opportunities, efficiency and energy of the Board and the organization, and will benefit the Company almost at once and automatically.

Very large salaries (amounts kept secret even from the Directors but believed to aggregate more than \$500,000 each) have been paid by your Company to a number of members of the Guggenheim family who were more interested in other concerns and who devoted most of their time and real effort to other matters. To what end were they given these offices and salaries? Since they sold out, certainly not because of their investment in the Company. Were their services of such value? The *Mining and Scientific Press* of San Francisco seems to hint to the contrary when it says: "To put it bluntly, would Mr. Simon Guggenheim be engaged as the Chief of the enterprise on account of his knowledge of mining and metallurgy, or of the business relating thereto, on his own merits as a technician and financier?" . . . "Similarly, most of the brothers and nephews might not be picked by other people to manage a mining and smelting business of large dimensions."

It has been the policy of Smelters and of other large industrial corporations to require their higher salaried men to make contracts to devote their "entire time, energy and skill" to the service of the Company. Were the numerous Guggenheims required to make such contracts?

If not, why not?

If so, what rights has your Company in the enormously valuable Chile Copper and other properties to the organization and development of which they devoted so much of the "time, energy and skill" which must have belonged to your Company?

The sum total of such salaries paid to the members of the Guggenheim family is very large, but it is as nothing compared with the value of opportunities which the Guggenheims sent elsewhere or compared to other possible losses due to having the actual management of the Company in the hands of those who were not primarily con-

cerned with the Company's financial success but were personally interested in the success of other and sometimes conflicting concerns, even if they had no intent to divert profits from your Company.

The vital necessity to this Company is an administration actively, solely, energetically and devotedly attempting to give it the best possible management and to bring to it all possible opportunities.

The lack of public confidence in the management has been indicated by the low average price and wide fluctuations of even the preferred stock of the Company, notwithstanding its excellent dividend record.

Do you wish your Company absolutely controlled by a group which has sold out practically all its stock, and at the same time has retained or acquired large holdings of other companies with conflicting interests?

Do you wish your Company to be controlled by those who give to Guggenheim Brothers, in which they are more largely interested, business which had been worth more than one and a quarter million a year?

Do you wish your Company controlled by men to whose personal profit it is to give the good opportunities to other companies in which they are much more largely interested and who have sold their poorer mines to your Company and turned their rich opportunities to other companies?

Do you wish your Company controlled by men who are much more largely interested in other enterprises with which Smelters will have business dealings than they are in your Company itself?

Do you wish the Guggenheims to determine what gifts shall be made—what contracts handed over—by Smelters to Guggenheim Brothers?

Do you wish your Company which naturally should be one of the greatest and most profitable industrials in the world and could easily be made so with an absolutely independent control and with competent management, to have a management whose financial interests would not actually be in the Company's success?

A number of stockholders, holding and representing substantial amounts of stock which have been practically in the same ownership since the formation of the Company, are co-operating to help the stockholders. Neither I, nor any other of these stockholders, is seeking any office or any personal gain other than through the enhanced value of his stockholdings. Our efforts are directed entirely to the correction of conditions for the benefit of all the stockholders.

A preliminary letter sent out on January 6th has resulted in the receipt of a large number of proxies and of many letters necessitating individual reply, which will be answered personally. It is desired to obtain the co-operation and assistance of as many stockholders as possible; in fact, the co-operation and assistance of the great body of stockholders will be absolutely necessary if they are to obtain the control of the Company for themselves and in their own interests. It will be required to overcome the proportion of proxies always automatically and thoughtlessly sent in to the management of a large

company, regardless of the achievements or errors of that management, and also to overcome the assistance which may be rendered the Guggenheims by their powerful associates in other enterprises.

This letter will be sent to all known stockholders, including those who have already replied to the former letter.

Please sign and return the enclosed form of proxy.

If those stockholders who feel disposed to assist by some personal activity in the effort to help themselves and all the stockholders, will so advise, some of us here who are interested will be pleased to correspond with them as to joint efforts to be made in their respective localities.

Very truly yours,

KARL EILERS.

The Economic Situation in Mexico

When the general depression that affected Europe began to spread to Latin America last summer and exchange sharply declined, attention was turned to Mexico, with hope for continued active markets, states a consular report. Mexican currency is today worth more on United States markets than that of any other country in the world, and the exchange rate has been recently above par. But in the latter part of November and in December occasional reports came in of the closing of mines and smelters; the price of silver began to drop at an alarming rate; the cotton crop was less than normal, and part of it was sold at prices below cost of production. Bank rates were raised, money became tight, and finally the Banking Company of Paris & Mexico went into the hands of receivers, and the Mercantile Banking Corporation was obliged to close its doors. The ports were badly congested, the railways were hampered by lack of equipment, both suffering from the results of labor troubles. Unemployment began to appear and wages were lowered, but the cost of living, particularly with regard to rents, continued to increase. It was reported that a large number of silver, copper, lead, and iron mines had been compelled to close, throwing about 10,000 miners out of work.

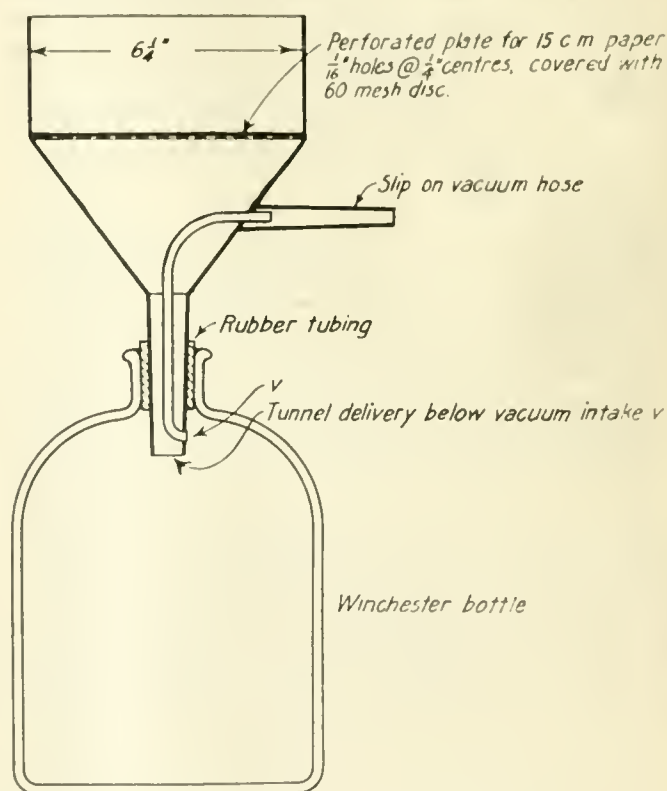
In spite of these unfavorable features, however, there is much in the situation to inspire confidence. The attitude of the Government has been in favor of the establishment of sound conditions. A new banking law is promised, which is calculated to encourage investment in Mexico. The President published a decree on January 11, 1921, providing that when the market value of electrolytic copper in New York City drops to 15c. or less per pound, the export duty is to be removed. A report from Commercial Attaché Jackson on January 19, 1921, states that the Banking Company of Paris and Mexico, under a receivership, and the Mercantile Banking Corporation were expecting to re-open within a few days. Another indication of expected prosperity is the opening in Mexico City of a branch of the American Banking Corporation on January 19. The production of coal is being

resumed and the railways are provided with fuel now that the Salinas coal strike is settled. The oilfields are prosperous in spite of congestion at the seaports, for the production of petroleum is greatly exceeding all previous records.

An Ingenious Filter

By A. T. FRY

The accompanying sketch shows a vacuum-filtering funnel which may be of interest. It is usually an advantage to see the filtrate when using vacuum, though by the use of a large opaque receiver, there is little risk of losing any solution. The usual vacuum flasks with side tube have lately been of indifferent quality, so I devised this funnel to make common glass acid-bottles available for use. The size of the neck of these bottles



is not large enough to permit using a two-bore cork, so I brought the vacuum tube in through the side of the funnel, down the inside of the stem and out about an inch above the stem end where the filtrate flows. Thus there is little risk of filtrate being sucked into the vacuum pipe.

A short piece of rubber tube slipped over the stem makes a good joint in the neck. The funnel may be made of iron for work with cyanide solutions, though copper or lead may be more suitable in other cases. The perforated plate should be stiff enough to remain flat when the suction is applied, for convenience in fitting papers in subsequent operation.

It is an advantage to solder a disc of 60-mesh screen on top of the perforated plate, blanking its edge with solder, thereby covering the edge of the paper in the usual way.



FROM OUR OWN CORRESPONDENTS IN THE FIELD

ARIZONA

GOOD ORE DEVELOPED IN DEAN MINE AT KINGMAN.

KINGMAN.—Financing of the National Five Gold Mines Co., that has taken over the property adjoining the Arizona Mossback Mines Co. to the south, has been completed. Charles H. Burlock, who was owner of the Arizona Mossback properties prior to their being acquired by the Arizona Mossback Mines Co., has been negotiating the deal with Arizona and Eastern capitalists. The property of the National Five Gold Mines Co. is on the same vein as the Arizona Mossback and near the old workings on the vein from which rich ore was taken in the past. The present plans of operation include the installation of equipment to sink to the 500-ft. level. Quarters for men and a pipe-line to Cottonwood creek, where water will be obtained, are to be constructed.

The Dean mine, which is situated 15 miles east of Kingman in the Maynard district, is carrying on development with about 30 men. A large body of ore 80 ft. to the east of the main cross-cut and averaging 14 oz. silver per ton for 14 ft. has been opened. In the west drift 90 ft. from the old raise a streak of ore 30 in. wide assays 300 oz. silver per ton. In the intermediate drift to the east of the old stope the vein is 12 ft. wide and is said to average 60 oz. silver, part of which occurs as native silver.

OATMAN.—A hoist moved from the Hi Henry mine has been installed at the Baltic mine, which lies to the north of the United Western and to the west of the Gold Road mine. Sinking is to be commenced immediately.

The drift on the 650-ft. level of the Gold Ore has reached the orebody, the width of which is to be determined immediately by cross-cutting. It is said that the ore at present exposed is high-grade mill-ore, but a better grade is expected, as this ore at the surface averaged about \$100 per ton.

TOMBSTONE.—A strike of high-grade silver ore, the largest that has been made in the district in recent years, has been made on the old Dragoon claims by lessees. The vein opened is said to be eight feet wide and will assay \$89 per ton.

COLORADO

GOOD OUTPUT FROM CRIPPLE CREEK MINES.

BLACK HAWK.—Sinking has been resumed from the 200-ft. level of the Silver Mountain Mining Co.'s main

shaft. Ore shipped from the bottom level has averaged \$160 per ton. The ore averages $\frac{3}{4}$ oz. gold and 15% lead, the remainder of the value being in silver. The shaft will be sunk an additional 60 to 75 ft. before running a new level, on the theory that the top of the shoot has been cut. The company has recently taken over the Linden Castle under bond and lease and is cross-cutting from the Silver Mountain tunnel to intersect the Linden Castle vein at depth.

CRIPPLE CREEK.—The January output as compiled by



PART OF SOUTH-WESTERN ARIZONA

mill and smelter reports totaled \$425,111. The 35,556 tons of ore shipped averaged \$11.95 per ton. The treatment follows: Golden Cycle mill, 15,000 tons of an average value of \$15, gross value \$225,000; Portland G. M. Co.'s Independence mill, 17,556 tons of an average value of \$5.56 per ton, bullion value \$97,611; Lincoln Mines & Reduction Co., 1000 tons averaging \$2.50 per ton, \$2500; smelters, 2000 tons averaging \$50 per ton, \$100,000.

Ore running from 6 to 29 oz. in the main Portland

vein at the 2450-ft. level is being developed with the drift. At the 23rd level the shoot was nearly 900 ft. in length and the grade high. Production has temporarily stopped from the No. 2 shaft to permit of the installation of the hoist formerly in use at the Gold Coin shaft of the Granite Gold Mining Co. in the city of Victor. The Granite company operations are now conducted from the Dillon shaft.

SILVERTON.—The Henrietta Silver Mines Co. is extending its tunnel, now in 400 ft., to cut the main Henrietta vein, that, in the shaft workings, averaged around \$35 per ton. The management has announced that its stock is not on the New York curb, but stock of another Henrietta company with properties in Colorado is listed. Negotiations are reported in progress looking to a merger of the two companies.

TELLURIDE.—Concentrate shipments from mills in the district in January amounted to 98 cars. The production at the several mills follows: Tomboy, 42 cars; Smuggler Union, 41; and Liberty Bell, 15. Construction of the flotation unit of the Smuggler Union plant has been delayed by heavy snowfalls. The walls nearing completion will now be covered with temporary sheet-iron roofing while machinery is being installed. Tetrahedrite ore assaying better than 100 oz. silver with some gold has been opened in the No. 2 tunnel of the Butterfly property at Ophir Loop by the Matterhorn Mining & Milling Co. Smelter shipments are reported as returning about \$125 per ton. The vein was cut at a point 700 ft. from the surface in undeveloped territory. Stoping is under way with the shoot holding its width and richness.

LEADVILLE.—Lessees on the Fanny Rawlins mine are producing and shipping about one car per week of rich sulphide ore, mined between the third and fourth levels, while lessees working on the first level have opened up strong bodies of lead ore, and operators on the second level are mining a good grade of gold-copper sulphide ore. The Fanny Rawlins company paid a dividend last year from royalties received.

MICHIGAN

HUGE CAKES OF COPPER EXPORTED TO GERMANY.

HOUGHTON.—The Michigan Smelting Co., which smelts mineral from the Copper Range mines—Champion, Baltic, and Trimountain—loaded 560,000 lb. of copper this week for Germany. This is the first copper sold by this smelter to Germany for a year and a half and is considered a hopeful augury. A shipment of 500,000 lb. went out this week from the same smelter to the Detroit Copper & Brass Rolling mills. This cleans up all big orders to date. The shipment for Germany was in the form of cakes weighing 6800 lb. each. The cakes were among the largest ever poured at the smelter, the size being according to specifications in the order. It is not known to what use they will be put. It required the erection of a derrick to load them on the cars. The shipment to Detroit was in the usual commercial sizes. Quincy is mak-

ing no shipments for export, but is shipping some metal East, as is Calumet & Hecla.

The Calumet & Hecla electrolytic plant at Lake Linden has been closed temporarily. It has been operating at only 50% capacity since the shut-down of Calumet & Hecla subsidiaries on November 16. Most of the silver recovered in the electrolytic plant came from the Osecola lode of Calumet & Hecla, Osecola Consolidated, including Kearsarge, Isle Royale, and White Pine. Of these, Isle Royale is the only one now operating and the plant will not re-open until a sufficient amount of Isle Royale silver 'rock' is accumulated.

Copper Range is taking on more men at its Champion, Baltic, and Trimountain mines, particularly at Champion. Champion has been down to as low as one-quarter its maximum underground force. Normally this mine employs 1200 men in actual mining operations. While it is not the intention to bring underground forces up to normal, in view of the continued depression in the metal market, a much better organization will be built up so that the shafts will be in position to take immediate advantage of any marked advance in the market. Baltic and Trimountain have from 40 to 50% of their maximum 1915-'16 force. Many of the men now being employed come from the Gogebie, Marquette, and Menominee iron ranges and are former residents of this district.

NEVADA

TONOPAH DISTRICT IS THRIVING.

TONOPAH.—Bullion shipments for the last half of January show that the rate of production at the Tonopah mills is the greatest in the history of the district. The production of the Tonopah Mining, West End, MacNamara, Tonopah Extension, and Belmont for the last half of January was 224,853 oz. of bullion, valued at \$277,800, or at a rate of more than \$6,650,000 yearly. The output of the mills includes bullion from ore shipped from nearby districts, but this is regarded as a minor factor.

WEST DIVIDE.—A second cross-cut on the tunnel, or 150-ft., level of the West Divide has entered the vein 150 ft. from the first cross-cut and a drift has been started from each cross-cut to connect them. A drift from the first cross-cut has for 40 ft. been in ore 2 to 4 ft. wide that assays \$100 to \$250, according to official statements, and the second cross-cut is in \$80 to \$100 ore. After the drifts have connected the cross-cuts an inclined winze is to be sunk in the vein and if the ore is persistent it is reported that shipping will be started and continued while a new shaft is being sunk to replace the present one, which cuts the vein at a depth of 50 ft. Ore of widely varying width and grade, but with an indicated average width of 3 to 4 ft. and an average value of \$70 to \$100, has been opened at depths of 50, 70, and 150 ft., the last representing about 200 ft. on the dip of the vein. Most of the work has been done at 50 ft., where the north drift is in a continuous ore-shoot for 70 ft., the lowest assay being 62 oz. silver and the highest 300 oz.

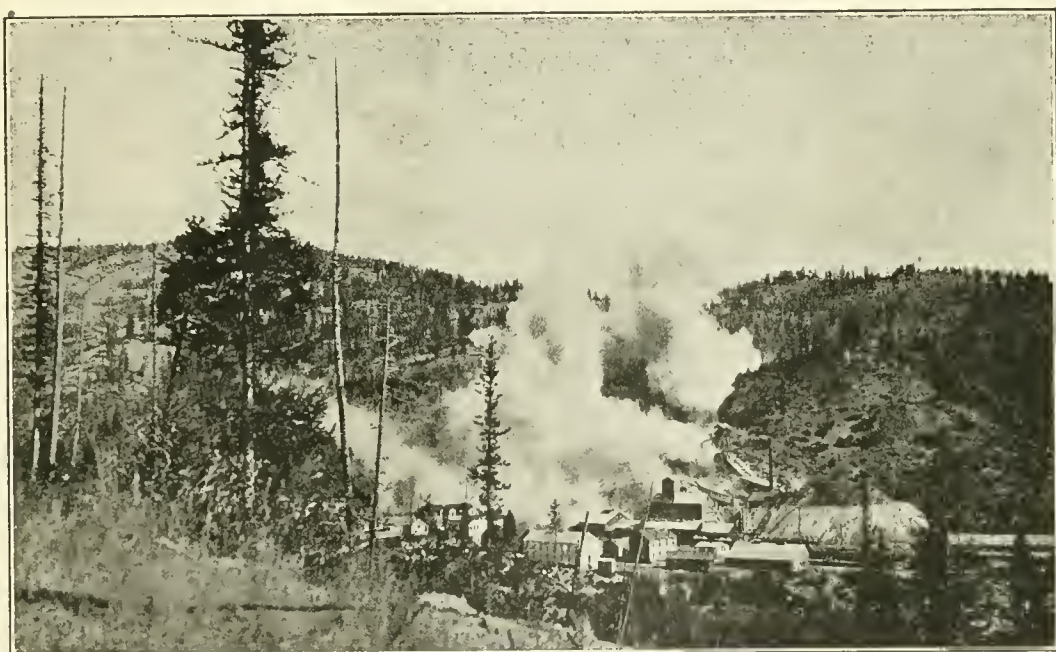
Rich ore was found south of the shaft at this depth, but the shoot is not persistent in this direction.

KLONDYKE.—It is reported that an engineer representing Eastern interests has completed an examination of the Original Klondyke, now being worked by lessees, and that there is a good chance for the mine to pass into the hands of men who will develop it thoroughly. The Knox is shipping at a rate of 25 tons daily, the ore assaying \$25 to \$30 in carload lots, and this rate of shipment is to be increased. The Lucky Boy Divide is moving machinery from Divide to claims owned by the company adjoining the Knox and it is reported that mining is to be started in 60 days. The Ben Hur is starting work far north-east of the Knox, and the Portland Klondyke is operating for the first time in many years, money

pushed from both ends. The total footage of this work during January was 364. Work is also progressing satisfactorily on a connection between the 1800-ft. level of the Chief and the Eagle & Blue Bell properties, which will improve ventilation in both mines.

Development work is being carried on at the May Day property through the Yankee Consolidated shaft. This work is on the 1800-ft. level and is almost directly below some of the older workings of the mine on the 1100-ft. level, where ore was found. It is stated that a raise will be put up from the 1800-ft. level.

During the week ending February 4, the Tintic Standard shipped 67 cars of ore; Chief Consolidated, 37; Iron King, 15; Eagle & Blue Bell, 13; Iron Blossom, 12; Victoria, 7; Dragon, 7; Gemini, 4; Centennial-Eureka, 4;



A LARGE BLAST AT THE MOTHER LODE MINE, GREENWOOD, B. C.

having been raised by J. B. Witt, formerly connected with the Witt-Brandon lease on the Florence Goldfield, through the sale of stock in Tonopah and Goldfield. It is reported that the Gold Seam is to ship.

UTAH

SILVER KING COALITION COMPANY PLANS TO RE-BUILD MILL AT ONCE.

EUREKA.—On February 2, the Chief Consolidated Mining Co. paid a dividend of 5c. per share, or a total of \$44,211. During 1920 the company paid quarterly dividends of 10c. per share, but the slump in prices of metals, together with extraordinary expenses in connection with sinking and concreting No. 2 shaft, rendered it advisable to cut the dividend. By February 20, a second connection will be made between the old workings and the new shaft at a depth of 1800 ft. At present there is a connection on the 1000-ft. level. In order to hasten the work on the 1800-ft. level, headings are being

Grand Central, 2; Gold Chain, 2; Bullion Beck, 1; Colorado, 1, making a total of 172 cars.

PARK CITY.—Conditions are reported as excellent at the Park-Utah mine by Paul Hunt, superintendent. This property is making steady shipments and has a total of 40 men on the payroll. A compressor and new mine-cars have been ordered to facilitate development work. The Park-Utah is controlled by the Judge interests.

Shipments from the Silver King Coalition have dropped off considerably as a result of the fire on January 27. During the week ending February 4, the Judge allied companies shipped 785 tons; Silver King Coalition, 273; and the Ontario, 205. The Judge smelter shipped 35 tons of premium spelter.

At a meeting of the directors of the Silver King Coalition Mines Co., on February 8, it was decided to begin immediately the work of preparing plans for a new concentrating plant. Construction will begin as soon as the weather permits, according to W. Mont Ferry, managing director. Inasmuch as the foundations of the old struc-

ture were unharmed by the fire, the new mill will be built on the same site. Several plans regarding the handling of mill ore, while the new plant is being constructed, are under consideration. At the time of the fire, G. W. Lambourne, president of the Judge M. & S. Co., tendered the Coalition company the use of any mill equipment the Judge company owned. The portal of the Alliance tunnel is close to one of the Judge mills, and concentrating ore could easily be transported through the tunnel to the milling plant.

BRITISH COLUMBIA

GRANBY CONSOLIDATED WINS SUIT.

VANCOUVER.—On February 3, the Granby Consolidated Mining, Smelting & Power Co. virtually won its two appeals against the decision of Justice Gregory, which gave the Esquimaux & Nanaimo railway title to the Cassidy collieries, now being operated by the Granby company. The Granby company was given full title to Dunlop property, and the Court found that title to the Ganner property was vested in the Granby company, but in case of assessment for damages in respect to the coal rights these are to be considered as 'coal in nature'. The outside price at this rate is stated to be \$150 per acre, so for the 200 acres involved the utmost that the Granby company would have to settle would be \$30,000. The counsel for the E. & N. Ry. gave notice of appeal to the Privy Council. The Granby company has spent fully \$2,000,000 on the development and equipment of these coal areas.

PRINCE RUPERT.—The output of the Granby company for December was 2,665,018 lb. of copper. The Drum Lummon mine, at Hartley Bay, is to be re-opened on April 1 under the management of C. A. Collins, and a hydro-electric plant is to be installed to replace the present internal-combustion engine plant. The mine yields both gold and copper ores, which in the past have been concentrated together; it is proposed to treat them separately in the future. The net earnings of the Belmont-Surf Inlet Mines, Ltd., for the quarter ended September 30 amounted to \$68,640.

POUNCE COUPE.—The Imperial Oil Co. has shipped an extra heavy oil-rig to Still River, whence it is to be hauled over the snow, and drilling operations are to be started here as soon as the weather permits. The site chosen for the boring is said to be just on the Alberta side of the inter-provincial boundary-line.

STEWART.—The Nabob group, in the Portland Canal district, is showing up well. Considerable tunneling has been done and latest reports state that 12 ft. of solid ore has been disclosed, both the hanging and foot-walls being well defined; the former is a black slate and the latter a well mineralized porphyry.

ONTARIO

INCREASED TAX ON NET PROFITS OF MINES IS BEING OPPOSED.

PORCUPINE.—The Supreme Court of Ontario has decided a long-contested dispute between the Township of

Tisdale and the leading mining companies, as to whether their mills were liable to municipal taxation, in favor of the companies. 'Concentrators' are exempt from local taxes under the Assessment Act, but the township contended that the term 'concentrators' only applied to mills using mechanical processes, and that the use of cyanide being a chemical process took them out of the exempted class. The decision of the court relieves the Dome, McIntyre, Davidson, and several other companies from local taxes on properties valued at about \$2,000,000.

The result of work on the 850-ft. and 1050-ft. levels of the Dome Mines has shown greatly increased enrichment of the ore at depth. A large tonnage of ore occurring in wide veins at the 1050-ft. level yields over \$20 per ton, as compared with about \$6 carried by the ore hitherto treated.

The Premier Paymaster, in the vicinity of the Dome, on which some \$100,000 was spent before it was compelled to close down, will shortly be re-opened, having been successfully financed in Boston. The shaft will be put down to 100 ft. to develop an orebody indicated by diamond-drilling.

COBALT.—Reports now in preparation by the mining companies in the district will show a general decline in ore-reserves as of the end of the year 1920. This decline is due in part to the shortage of labor which existed during the first nine months of the year, as well as to the power shortage during the closing quarter. It is chiefly due, however, to the decline in quotations for silver. This has relegated a large tonnage of silver-bearing material to the classification of waste. The McKinlay-Darragh is expected to show a decline of close to 50%, with a decline of upward of 25% for the Nipissing.

A financial statement issued by the Nipissing shows liquid assets of \$4,921,010 as of January 3. This was prior to the distribution of a regular 5% dividend plus a bonus of 5%, which called for the payment of \$600,000. A feature in connection with the Nipissing is that the dividends were distributed among 13,000 shareholders, making an average of about 92 shares held by each stockholder.

During 1920 the Crown Reserve Mining Co. experienced an operating loss of \$72,054. The surplus was reduced to \$512,481, which is equal to about 25¢. on each issued share. The company received no dividends during the year from the Porcupine Crown mine, which it controls.

The Ontario Minister of Mines has issued an advance notice that the mining-profit tax of the Province may be increased this year. The present tax is 3% on the first million dollars earned, and 5% on all amounts exceeding one million. The proposed increase would impose 4% on the first million with 7% on all amounts exceeding that figure. This increase would apply to the silver and gold mines, and a general protest has been raised in the silver and gold mining districts, where the belief exists that the Government should reduce the difficulties under which the industry labors rather than create an additional burden.



PROPOSED INVESTIGATION OF A. I. M. & M. E. AFFAIRS

Following the receipt of the notice of a \$10 assessment to meet an impending deficit in the finances of the Institute, the San Francisco Section addressed the following resolution to the directors in New York on January 11, 1921.

"The San Francisco Section is not entirely in accord with the action of the finance committee of the Institute in debiting the members' accounts with a charge of \$10, leaving the payment or non-payment of same to the discretion of each member, with no alternative to pay a lesser amount.

"The Section desires to be advised regarding the necessity for this action, which appears to be establishing a dangerous precedent.

"With no desire to criticize the action of the committee in adopting such course, the Section respectfully suggests that a committee be appointed to examine (and report on) the finances of the Institute and to submit a report with recommendations; whereby the future expenses of the Institute shall not exceed its income.

"The Section suggests that the committee shall consist of seven (7) members, three of whom shall be thoroughly conversant with editorial and publication work."

This elicited a reply addressed to C. H. Fry, secretary of the San Francisco Section and signed by Bradley Stoughton, secretary of the Institute, quoting from the minutes of the directors' meeting and urging prompt action by the San Francisco Section. The quotation from the minutes reads:

"Appreciating the deep concern in the welfare of the Institute which has been characteristic of the San Francisco Section, and sensible of the continued support which the Institute can always expect from our Pacific Coast members, the board of directors would ask the San Francisco Section to suggest the personnel of the committee which it has spoken of in its recent communication, in order that the investigation proposed may be conducted in a manner and by persons entirely acceptable to our San Francisco members.

"Resolved, that the officers of the Institute be instructed to furnish the San Francisco Section full information to carry out the proposed investigation."

At the meeting of the San Francisco Section held on February 8 it was decided to suggest the following representative members of the Institute, who reside in or near New York, to serve on the investigating committee: C. R. Corning, Arthur S. Dwight, Walter R. Ingalls, E. W. Parker, and Robert M. Raymond.

FINANCING THE SURPLUS COPPER

Plans for financing the sale for export purposes of 400,000,000 of the 600,000,000 lb. of surplus copper in the American market have been made public, with the announcement that the product was pledged as security for \$40,000,000 8% notes of the Copper Export Association, to be offered for public sale by a banking syndicate headed by the National City Co. and the Guaranty Trust Co. of New York. The inclusion of companies outside the Copper Export Association is an important feature, as it is certain to result in more rational viewing of the copper problem by all concerned. As a result the loan becomes one of far-

reaching importance, and should prove in its indirect results to be one of the most constructive moves that have been made to help tide the copper industry through this period of depression. This is said to be the first large public loan made in this country to be secured specifically by a certain amount of an essential commodity, as well as the first big movement by American companies to take advantage of the opportunities offered under the Webb export trade act to invite public participation in the financing of foreign trade. Under provisions of the Edge law, allowing combinations for export trade only, agreements as to price and supply may be entered into, and on this account the copper to be pooled must be 'ear-marked' for foreign consumption.

The heavy accumulation of surplus copper was the result of the sudden ending of the War and the inability of European consumers to take their usual requirements. The 400,000,000 lb. is only about three-fourths of the export trade done by this country last year and, in the opinion of producers, if marketed over a reasonable period it will be easily absorbed. The present rate of production is said to be below the deliveries of copper in 1919 and 1920, making a further heavy accumulation improbable. The notes to be issued for the loan are being offered at prices to yield from 8 to 8.30%. The current price of about 13c. per pound compares with an average market price for refined copper of 16½c. over the last 20 years, and with a low record price during that period of 11 cents.

THE MAYO DISTRICT IN THE YUKON TERRITORY

Reports from Dawson indicate that the Mayo district in the region of the Upper Stewart river has been developed to a point where its permanence as a productive mining locality is assured. Geologists and mining engineers who have visited Mayo state that a zone having every formation favorable to extensive silver-lead deposits runs athwart the area for at least 25 miles, with a width of 10 miles. Within this strip there are eight hills upon which locations have been made and development done with excellent results. Nearly a thousand claims have been staked in these localities, which are known as: Keno Hill, Lookout Mountain, Stand-To Mountain, Rambler Hill, Galena Hill, Galena Creek, Mount Hinton, and Mount Cameron. Veins from several inches to five feet wide are said to have been discovered and the assays reported range from \$200 to \$5000 per ton in silver and lead. Returns from \$200 to \$500 are common. The Yukon Gold Co., which is proceeding with extensive development, plans to have 3000 tons of sacked ore hauled out this winter for shipment by water by way of St. Michael when navigation opens.

ALASKA

Juneau.—D. C. Jackling, of the Alaska Gold Mines Co., has announced that a portion of the milling and power plants, owned by the company and originally constructed to treat the gold ores from the Juneau mine, will be converted into wood-pulp mills. The raw material is obtainable in the vicinity of the company's property, and in view of the fact that the mining operations have been conducted at a loss for some years, the change seems logical.

CALIFORNIA

Amador County.—The work of repairing the caved workings on the 3900-ft. level of the Argonaut mine is practically completed, and unwatering below that level will be resumed. The objective is the 4900-ft. level, where high-grade ore had been exposed prior to the time when the mine was flooded to overcome the fire. Among the mines employing many miners are the Central-Eureka, Old Eureka, Fremont, and Bunker Hill. All of the towns in the vicinity show signs of returned prosperity such as prevailed prior to the War.—The Morning Star company is preparing to increase the capacity of its mill at Mokelumne hill from 250 to 1000 tons per day. It is reported that the main orebody is 75 ft. wide and that recent developments have largely increased the ore-reserves. The company is also sinking a shaft at the Moser property.

Nevada County.—H. L. Ostrander, manager of the Alta-Combination placer mine, has completed the erection of a saw-mill, air-compressor, shops, and power plant, and is ready to proceed with underground work. The adit is expected to tap the old Alta Hill channel, which yielded good gravel years ago.

San Francisco.—At the regular monthly meeting of the San Francisco Section of the A. I. M. & M. E., held on February 8, C. M. Eyr gave an excellent paper on 'Development of the Mineral Resources of the Philippines', and E. H. Clausen spoke interestingly on 'Geology and Mining Conditions in the Aroroy District'.

San Pedro.—Excellent results are being obtained from tests made by Fred Thomas at Harbor City, for the purpose of perfecting a scheme for manufacturing zinc oxide. An antimony plant, built during the War at a cost of \$200,000, has been acquired. The zinc oxide is not of as good grade as it is hoped to make, but further improvements in the manipulation are expected to result in a better product. M. P. Kirk, at one time manager of the Yellow Pine mine near Good Springs, Nevada, is working on the process.

Ubehebe.—Four trucks are now hauling ore from the Arrowhead Rico, two having been added recently. Returns from the second carload shipment give a content of 59% lead and 35 oz. silver per ton. The lower tunnel will be completed in ten days. This tunnel was advanced 32 ft. in the last three days. It is being driven in soft lime and the contractor receives \$6.50 per foot.

COLORADO

Boulder.—The Tungsten Products Co. has made its first shipment of radium from the local plant. The product, which is in the form of bromide, was worth \$50,000. It will be shipped to the company's laboratories in the East for further refining.

Dumont.—Work on the Bonanza group of mines on Mill creek is progressing. A tunnel 700 ft. long is being driven to connect with the shaft.

Georgetown.—The Denbigh Silver-Lead Mines Co. is extending the 13th level of the Terrible mine into new territory and is taking out ore necessary to this development. The vein contains a 12-in. seam of ore sampling around 100 oz. silver and \$10 gold per ton.

Idaho Springs.—The Gem Mining Co. is reported to have taken up the option on the Argo tunnel and mill, the purchase price being in the neighborhood of \$250,000. The Argo tunnel will be remembered as the old Newhouse tunnel, started in 1893. It is now four miles long. About 80 men are engaged in development work, including the lessees.—The installation of a new 75-hp. hoist at the Freighter's Friend has been completed.—The Metropolitan mine, situated up Spring gulch and at the foot of Freeland gulch, will begin work soon. M. J. Reiley has secured a lease on both the tunnel and shaft.

IDAHO

Coeur d'Alene.—In the upper workings of the Success mine a vein of clean silver-lead ore averaging from one to three feet in width has been revealed. When the lessees started work they began drifting on a narrow stringer of ore, and it widened out in a short distance to its present width. The ore in the granite contains silver and lead with little zinc except in the lower levels where the zinc content is important.—Operation of the West Sunset property, adjoining the Tamarack holdings, has recently been started from the shaft of the Sunset mine, which is 1000 ft. deep. The shaft was unwatered recently. It is reported that a 10-in. streak of high-grade silver-lead ore has been exposed.—Development work at the Silver Cable property in the East Coeur d'Alene district is soon to be resumed. The Silver Cable mine is situated seven miles east of Mullan, and is developed by two tunnels.—Leasing operations on the Dobson & Jim property, situated in Dobson gulch between Wallace and Murray, will be started soon. A shoot of high-grade ore a foot wide has been opened in the property and work will begin shortly, hand-sorting the ore and shipping it to the Bunker Hill smelter.—The Ten to One Mining Co. has been organized to take over and operate the property of the old Coeur d'Alene Silver-Lead Development Co., consisting of 18 claims in the Murray district, according to W. W. Johnston, of Spokane.

Lemhi County.—The total value, after paying smelter charges, of the output of the Pittsburgh-Idaho mine at Gilmore has been \$5,350,000. The principal metal is lead with considerable silver and a little gold. The company is preparing to sink its three-compartment shaft from the 700 to the 800-ft. level.

Montpelier.—The Pegram Mining & Milling Co., owner of a large deposit of low-grade gold ore assaying from \$4 to \$6.50 per ton, is preparing for the erection of a cyanide plant at its property near here. A carload lot of ore was shipped to Denver, where tests were made to devise the best method of treatment. The Oregon Short Line R. R. Co. has surveyed a spur track to the property.

MONTANA

Butte.—Two bills introduced in the legislature at Helena are meeting opposition. One imposes a tax on the net revenue amounting to one-half of 1%; 'net revenue' is considered to mean the remainder of the income after deducting payment for labor, supplies, and safety-first work, but exclusive of depreciation, betterments, additions, replacements, and salaries of officials. A second bill contemplates an increase in the rate of compensation for injured workmen. It is contended that such a measure is unwise, in view of the present unsatisfactory condition of the metal market.—The East Butte company has taken advantage of curtailed production to put the Pittsmtont mine in shape for maximum output at economical cost. Ore mined during the past six months has averaged between 4½ and 5% copper. The company has started shipping its blister copper to the refinery of the Anaconda company at Raritan, New Jersey, instead of to the Nichols plant on Long Island.—The Davis-Daly Copper Co. has reduced its operations to one shift, 225 men being employed as compared with 350 a fortnight ago; 200 tons of ore per day will be mined.

Dillon.—Henry Auerbach, president of the Silver Spring Mining Co., has taken four samples from an 80-ft. shaft on the company's property 21 miles south-east from here. The average assay is 20% copper, \$3.75 gold, and 2 oz. of silver. There are six veins outcropping on the surface. A 25-hp. gasoline hoist will be sent to the property.

Helena.—R. P. McDonald, interested in the Lee mine in the Rimini district, states that the company expects to erect

a mill to treat low-grade silver-lead ores being mined.—The State Railroad Commission has authorized the railway companies in Montana to reduce freight-rates on iron ore used for fluxing purposes at the East Helena smelter, from \$4.40 to \$3.30 per ton. The ore comes from White Sulphur Springs and is of exceptionally good quality for use in the smelter.—The adit of the Chicago-Montana property is being advanced, and within a month the vein of copper ore is expected to be cut. The same company owns the Economy mill near-by, which represents an investment of more than \$300,000.

NEVADA

Cuprite.—Ernest D. Foster states that the Foster Mines Co. had ordered machinery for mining and milling a large deposit of silica, which is to be shipped East to be used in the manufacture of glass. 'Pre-shrunk' silica, made by melting the crude product and re-grinding, is used for the manufacture of an especially good silica brick.

Goldville.—The recently planned remodeling of the mill of the Lynn Big Six Mining Co., 21 miles north-west of

light M. & M. Co. will soon start operating under the supervision of W. W. Wells.

Tonopah.—The drift on the 1400-ft. level of the Tonopah Belmont, the lowest depth at which mining is being done, has exposed a full face of ore on the Belmont vein. This adds materially to the ore-reserves in the mine. The mill is working at capacity on ore from the Belmont mine and from other properties in Tonopah and Divide that send their ore on a custom basis.

UTAH

Beaver County.—The Gold Crown Mining Co. has shipped silver ore which averaged \$100 per ton, according to James Kirk, superintendent.—It is reported that the Beaver Copper Co. will resume operations about March 1. This property is 11 miles north-west of Milford, and has been developed by an inclined shaft to the 470-ft. level. Two cars shipped by lessees from this property recently averaged 40% lead and 17 oz. silver.

Bingham.—During 1920, the Utah-Apex Mining Co. produced 117,784 tons of ore, which yielded 1912 oz. of gold,



INTEROCEAN MINE, BOULDER COUNTY, COLORADO

Carlin, is progressing. The equipment consists of a gyratory crusher, compact screens, Hardinge ball-mill, amalgamating-plates, and Wilfley tables. R. M. Holt is secretary-treasurer for the company.

Mina.—The proposal of the Nevada-California Power Co. to remove its transmission line between Aurora and Hawthorne is being protested by the citizens of Hawthorne. The purpose of the proposed plan is to obtain material for the power-line connecting Millers with the Simon silver-lead mine.

Ploche.—L. G. Gillett, superintendent of the Virginia-Louise mine, has blocked out a large quantity of additional ore on the third and fourth levels of the mine. Development work on the fifth level is revealing a satisfactory increase in the ore-reserves.

Searchlight.—The Big Casino Leasing Co., of which M. D. Rossiter is superintendent, has repaired its main shaft to the 300-ft. level, preparatory to extracting ore from that level. The shaft will be cleaned as far as the 6th level.—The Duplex mine is shipping steadily to Salt Lake smelters. George R. Colton is managing director.—The Goodhope, adjoining the Quartette mine, is being rehabilitated by F. W. Knable and associates of Denver, Colorado.—The Search-

336,587 oz. of silver, 20,667,181 lb. of lead, 7,257,765 lb. of zinc, and 840,213 lb. of copper, the gross value of which was \$1,634,516. The company estimates the value of its property, for taxation purposes, at \$137,500.

BRITISH COLUMBIA

Quesnel.—The California-Cariboo Gold Dredging Co. has been incorporated under the laws of California, for the purpose of dredging the lower 10 miles of the Cottonwood river. The company intends to install a California-type gold dredge upon the completion of the Pacific Great Eastern railway to the Cottonwood about July. The officers are: E. L. Pilling, president; J. E. Platt, treasurer; B. H. Paul, secretary; and W. W. Wishon, engineer.

MEXICO

Monterrey.—Although reports have been received here of the resumption of mining and milling operations in the States of Durango, Chihuahua, and other parts of the country, the conditions in the Monterrey district are not so good. The American Smelting & Refining Co. shut-down its smelter here a few days ago and development work upon a number of the larger producing mines from which the smelter derives its chief supply of ore has been suspended.

It is stated that the smelter will probably not resume operations for several months. Several thousand employees were thrown out of work by the closing of the plant. Labor conditions in this part of Mexico are unsettled and this fact, together with the unsatisfactory metal market, is given as the cause for the closing down of the smelter and mines. The situation as regards fuel, which for a time threatened seriously to hamper the smelting and mining industry, is much improved. Enormous quantities of coal are being shipped into Mexico from the mines in Texas, especially those at Eagle Pass.

Tampico.—Exports of oil from Mexico for 1920 totaled 153,795,000 bbl., as against a total of 79,927,000 in 1919, an increase of 73,868,000 bbl., or almost 100%. The big companies increased their shipments from 3,000,000 to 16,000,000 bbl. each. Mexican Petroleum Co., the largest shipper for the year, exported 28,687,000 bbl., and showed a gain of 16,701,000 bbl. over 1919. Standard Oil Co. of New Jersey shipped 20,197,000 bbl. in 1920, an increase of 11,504,000. Mexican Eagle Oil exported 20,289,000 bbl., a gain of 7,765,000. Large increases in 1920 shipments were made by Island Oil, Texas company, Gulf Oil, and Sinclair Oil, ranging from 3,000,000 to 6,000,000 bbl. each.

Torreón.—Luis C. Ratto, representing the Santa Cecilia Mining Co., has taken up a number of new mining claims in the Ramirez mountains, near San Juan de Guadalupe. This company is composed principally of Americans who will develop several groups of mines in that vicinity. Their new properties adjoin the San Acasio group.—Jose Alonso, of San Antonio, Texas, was here recently on his way to the Tamazula mining district, where he has filed on some new claims which he is developing. The properties include two filings of several claims, each of which is traversed by veins of gold and silver bearing ores. Thomas Gaya has located a group of six promising prospects in the Panuco de Coronado region. The properties are contiguous to the Trinidad and Washington mines which have produced considerable rich ores. Mr. Gaya expects to be able to commence the shipment of ore during the coming month.

ONTARIO

Cobalt.—The Porcupine Associated Gold Mines, Ltd., has been organized with a capital of \$5,000,000. The purpose is to merge the interests of the La Palm, Three Nations, Dominion-Porcupine, and Veteran properties, the total area being 720 acres. Development work will be commenced at once.—Operators of silver mines are opposing the contemplated plan of the Government to increase the profit-tax on the mines of the Province. They point to the higher price being paid for silver in the United States as compared with that obtained for Canadian silver, as an argument against the proposed tax.

PERU

L. T. Haggin, of the Cerro de Pasco company, has estimated that last year's profits were at least \$4,000,000. This would be equivalent to approximately \$4.47 per share on 898,119 shares outstanding. The company appears to have been one of the few big copper producers that succeeded in earning its dividend last year. This estimate of 1920 earnings does not include undistributed profits of subsidiary companies which have amounted to something like \$1,000,000 annually the last four years. Cerro de Pasco is also affiliated with American Metal Co. in which it has an ownership of about 4500 shares, representing an investment of \$747,000. American Metal refines and sells its product. The company's copper production last year totaled 52,878,000 lb., against 58,124,000 in 1919, 71,906,800 in 1918, and 72,674,032 in 1917, its banner year. Today its silver output constitutes more than 11% of its annual metal production, and is increasing.

PERSONAL

The Editor invites members of the profession to send particulars of their work and appointments. The information is interesting to our readers.

Robert A. Künzle has returned to San Francisco from the west coast of Mexico.

Frederic R. Weekes has left New York for the West on professional business.

D. D. Moffat is visiting the Mesabi Iron Co.'s properties at Hibbitt, Minnesota.

Ray J. Barber is now at Hurlingham. He will open an office in San Francisco.

H. Vincent Wallace is leaving Los Angeles for Salina Cruz, Mexico, on February 21.

M. W. von Bernewitz has severed his connection with the 'Mines Handbook' at Tuckahoe, New York.

Engene G. Suedaker passed through San Francisco on his return from Bagdad, Arizona, to New York.

L. S. Cates, general manager for the Ray Consolidated Copper Co., has returned to Salt Lake City.

R. B. Kepner has opened an office as consulting mining engineer in the Washington building, Los Angeles.

John M. Fox, superintendent for the Belmont Wagner Mining Co., has resigned and is now in San Francisco.

W. W. Wishon recently completed an examination of the Sixty Three group, on Stockton hill, near Kingman, Arizona.

G. W. Heintz, vice-president and general manager for the U. S. Smelting, Refining & Mining Co., was at Salt Lake City last week.

R. C. Gemmell has returned to Salt Lake City after visiting the Chino Copper and Ray Consolidated properties in New Mexico and Arizona.

Alex Schloesser has resigned as engineer in charge of the engineering department of the southern division of Miller & Lux, to accept a position with the Mexican Candelaria Co., at Durango, Mexico.

A. R. Elliott, formerly assistant petroleum engineer of the U. S. Bureau of Mines, with headquarters at the San Francisco office of the Bureau, has resigned to accept a position with the Pierce Oil Corporation at Oklahoma City.

E. L. Pilling, president, and W. W. Wishon, engineer, California-Cariboo Gold Dredging Co., recently visited San Francisco in regard to the purchase of machinery for the first dredge on the Cottonwood river near Quesnel, B. C.

J. A. Bancroft, professor of geology in McGill University, has been appointed assistant general manager for the Granby Consolidated Mining, Smelting & Power Co. He will take up his new duties at the close of the present university session.

E. E. Campbell has resigned the position of assistant general manager for the Granby Consolidated Mining, Smelting & Power Co., Ltd., at Anyox, B. C., to accept the position of general superintendent for the United Verde Extension Mining Co., at Jerome, Arizona.

Obituary

Abe Erickson, an employee of the Woodlawn Copper Co., at Alta, Utah, was electrocuted on February 4. A fire was discovered in the company's compressor plant, caused by a short-circuited wire. Erickson threw a bucket of water on the sputtering wire and fell dead. Officials of the company believe the electrocution was caused by the forming of a contact with a high-voltage power-line when Erickson threw the water on the short-circuited wire.



METAL PRICES

San Francisco, February 15

Aluminum-dust, cents per pound.....	65
Antimony, cents per pound.....	9.50
Copper, electrolytic, cents per pound.....	13.50—14.00
Lead, pig, cents per pound.....	5—6
Platinum, pure, per ounce.....	\$70
Platinum, 10% iridium, per ounce.....	\$100
Quicksilver, per flask of 75 lb.....	\$50
Spelter, cents per pound.....	8.25
Zinc-dust, cents per pound.....	12.50—15.00

ZINC

Zinc is quoted as spelter, standard Western brands, New York delivery, in cents per pound.

Date					
Feb.	8.....	5.50	Jan.	3.....	Average week ending 6.04
"	9.....	5.50	"	10.....	6.00
"	10.....	5.35	"	17.....	6.00
"	11.....	5.35	"	24.....	5.96
"	12 Holiday		"	31.....	5.42
"	13 Sunday		Feb.	7.....	5.40
"	14.....	5.35	"	14.....	5.41

EASTERN METAL MARKET

(By wire from New York)

February 14.—Copper is quiet and firm. Lead is inactive but easy. Zinc is dull but steady.

SILVER

Below are given official or ticker quotations for silver in the open market as distinguished from the fixed price obtainable for metal produced, smelted, and refined exclusively within the United States. Under the terms of the Pittman Act such silver will be purchased by the United States Mint at \$1 per ounce, subject to certain small charges which vary slightly but amount to approximately three-eighths of one cent. The equivalent of dollar silver (1000 fine) in British currency is 46.65 pence per ounce (925 fine), calculated at the normal rate of exchange.

Date	New York cents	London pence	Average week ending Cents	Pence
Feb.	8.....	61.37	3.....	65.40
"	9.....	62.00	" 10.....	66.60
"	10.....	62.12	" 17.....	66.14
"	11.....	62.25	" 24.....	66.56
"	12 Holiday		" 31.....	64.52
"	13 Sunday		Feb.	7.....
"	14.....	60.75	" 14.....	61.70

Monthly averages

	1919	1920	1921
Jan.	101.12	132.77	65.95
Feb.	101.12	131.27	...
Mch.	101.12	125.70	...
Apr.	101.12	119.56	...
May	107.23	102.89	...
June	110.50	90.84	...

Monthly averages

	1919	1920	1921
July	106.36	92.04	...
Aug.	111.35	96.23	...
Sept.	113.92	93.66	...
Oct.	119.10	83.48	...
Nov.	127.57	77.73	...
Dec.	131.92	64.78	...

Monthly averages

	1919	1920	1921
Jan.	103.75	89.00	50.00
Feb.	90.00	81.00	...
Mch.	72.80	87.00	...
Apr.	73.12	100.00	...
May	84.80	87.00	...
June	94.40	85.00	...

Monthly averages

	1919	1920	1921
July	100.00	88.00	...
Aug.	103.00	85.00	...
Sept.	102.60	75.00	...
Oct.	86.00	71.00	...
Nov.	78.00	56.00	...
Dec.	95.00	52.50	...

SILVER'S DEFLATION

Like the other of the non-ferrous metals, silver shows little inclination to advance in price. The metal is now selling at under 60c. per ounce, or virtually the low of last December and compared with the high of \$1.37 per ounce in 1920, it has been more than cut in half. The market for so-called domestic silver still remains at 99½c. to \$1 per ounce, sustained by periodical purchases of silver from American mines by the Government to replenish the treasury. This silver must be bought at \$1 per ounce and only from domestic producers.

The meteoric history of silver during the war years is no less sensational than that of the rest of the metals. Stimulated by a world shortage, which was induced by a fear of paper money and consequent hoarding of the white metal by Europeans, the price of silver kept steadily rising. America was compelled to settle much of her purchases in Japan, the Orient, and India with silver dollars. Paper money in those countries is looked upon with suspicion and this country melted down and shipped over 240,000,000 silver dollars to Japan, India, China, and other countries of the Orient. The price advanced to \$1.37 per ounce.

The old economic truth that rising prices stimulate production again proved true. Silver was dumped on the market by European nations who found a profit in melting their coins and selling the bar silver in the open market. The crisis in Japan and to some extent in India cut off further demand from these sources and the metal had a precipitate drop from the high of \$1.37 to a low of under 60c. touched last December.

As a protection for American producers, the Treasury Department announced that under the Pittman Act the Government would begin purchasing back the silver it had melted at a price of not less than \$1 per ounce. This has stabilized the price for domestic silver.

Commercial silver is selling at about 60c. and the big producers of Canada and Mexico—Nipissing and the Cobalt operators above our northern border, and Greene-Canauea and Cerro de Pasco in the Latin countries—are prohibited from receiving the Government price of \$1 per ounce, being foreigners.

Up to the present time the Treasury Department has purchased back nearly 33,000,000 oz. of silver. There remain 176,000,000 oz. yet to be purchased. All this metal will be bought from domestic mines which on the rate of last year's output of approximately 51,000,000 oz., means the entire production of this country for the next four years, provided, of course, the treasury takes the metal as fast as produced.

The following table shows production of the United States and average prices for silver in the last 10 years.

	U. S. production, oz.	Average price, cents.
1920	54,250,000	100.86
1919	55,285,000	111.50
1918	67,810,000	96.75
1917	71,740,000	81.41
1916	74,414,000	65.66
1915	74,961,000	49.69
1914	72,155,000	54.81
1913	66,801,000	59.80
1912	63,766,000	60.83
1911	60,399,000	53.30

LEAD

Lead is quoted in cents per pound, New York delivery.

Date					
Feb.	8.....	4.75	Jan.	3.....	Average week ending 4.62
"	9.....	4.70	"	10.....	4.78
"	10.....	4.70	"	17.....	5.11
"	11.....	4.70	"	24.....	5.11
"	12 Holiday		"	31.....	4.89
"	13 Sunday		Feb.	7.....	4.79
"	14.....	4.70	"	14.....	4.71

Monthly averages

	1919	1920	1921
Jan.	5.00	8.05	4.96
Feb.	5.13	8.88	...
Mch.	5.24	9.22	...
Apr.	5.05	8.78	...
May	5.04	8.55	...
June	5.32	8.43	...

Monthly averages

	1919	1920	1921
July	5.53	8.63	...
Aug.	5.78	9.03	...
Sept.	6.02	8.08	...
Oct.	6.40	7.28	...
Nov.	6.76	6.37	...
Dec.	7.12	4.76	...

TIN

Prices in New York, in cents per pound.

	1919	1920	1921
Jan.	71.50	62.74	35.94
Feb.	72.44	59.87	...
Mch.	72.50	61.92	...
Apr.	72.50	62.17	...
May	72.50	54.99	...
June	71.83	48.33	...

Monthly averages

	1919	1920	1921
July	70.11	49.29	...
Aug.	62.20	47.00	...
Sept.	55.79	44.43	...
Oct.	54.82	40.47	...
Nov.	54.17	36.97	...
Dec.	54.94	34.12	...

MONEY AND EXCHANGE

Foreign quotations on February 15 are as follows:

Sterling, dollars:	Cable	3.92½
	Demand	3.93½
Francs, cents:	Cable	7.47
	Demand	7.49
Lire, cents:		3.76
Marks, cents		1.75

Eastern Metal Market

New York, February 9.

Improvement in demand is only slight in some metals but prices are fairly steady to firm.

The copper market is firmer and demand is a little better. A fair business has been done in tin almost daily with prices easy to steady.

Lead is very quiet and a little lower.

The zinc market continues lifeless with the quotations practically unchanged.

Antimony is nominally the same as a week ago.

IRON AND STEEL

Announcement by the Midvale Steel & Ordnance Co. that it would quote prices low enough to bring business to its mills, some of which have been shut-down since early December, has brought the steel market this week to a new stage in price readjustment. Thus far no large business has been done, but already cuts of \$5 per ton below the Steel Corporation's schedules are reported. There are plentiful indications that other independent steel companies stand ready to take a share of the going business, even though realizing that under present conditions there will be no free buying.

The crux of the new situation is the extent to which the wage reductions already made by some independent producers will allow them to go below Steel Corporation prices. These reductions have been from 15 to 25%.

Competition in steel from the continent of Europe looms up as a large possibility in all export calculations, Germany's chances growing better. Some German punching and shearing machinery undersold American machines in northern Ohio this week.

COPPER

The chief interest of the week has been the attempt to arrange a method of financing the 400,000,000 to 500,000,000 lb. of copper stocks. It is understood that this has been accomplished but the details are not yet available. The plan is to finance this metal for the export trade and the whole scheme is regarded favorably in all circles. Whether all companies will enter the arrangement is also not known. The effect of these plans on general sentiment has been good, so much so that the London market has advanced £2 to £3 per ton in the last week or about \$10 per ton in American money. Prices here are also slightly higher and the market tone is stronger. Electrolytic copper is quoted at 13 to 13.25c., delivered, for early delivery with 13.25 to 13.50c. asked for March-April. Lake copper is held at 13.50c., delivered. Demand, particularly from foreign buyers, is reported as improved.

TIN

The market has been fairly active at least up to Friday of last week, sales each day being estimated at 125 to 150 tons. Dealers were again the principal buyers, though consumers were also well represented. A quiet but steady business was done but the advance which started in London late during the week checked this movement. The market therefore has been very quiet since Friday. It has been many weeks since any sales have been recorded on the New York Metal Exchange, but on last Friday 75 tons was sold, all February-March-April shipment, at 32 to 32.50c. No definite news is yet available regarding the reported lowering of the Malay government's purchasing price to £205, but this is expected any day. Spot Straits, New York, has hovered around 32 to 33c., New York, the past week and was quoted yesterday at 32.50c. Prices in London were lower yesterday than a week ago at £164 for spot standard, £169 for future standard, and

£184 for spot Straits. Arrivals thus far this month have been 960 tons with 2535 tons reported afloat.

LEAD

Demand is light and the market is quiet and without feature. More consumers are covered by contracts on which deliveries are progressing regularly. Prices are a little lower than a week ago. The leading interest's quotation is unchanged at 4.75c., New York and St. Louis, but some independents are down to this level at New York and appear to be offering enough to satisfy present demand. The nominal quotation for spot is 5c., New York, with the St. Louis quotation at a minimum of 4.50c.

ZINC

Since last week definite information has been secured to the effect that 10,000 tons of German-made zinc was recently sold for shipment to this country. The sale was made at 4.50c. per pound in bond, which figures at about 5.12½ to 5.17c., duty paid. It is known that offerings of foreign zinc, probably German, have been made at around 5.25 to 5.35c., seaboard. While considerable has been made of this competition, it is not believed by some that the quantity available from that source is heavy. The market is stagnant and "sick", to quote one seller. Demand is very light and shows no improvement. Prime Western is quoted at 5c., St. Louis, or 5.50c., New York, for the domestic metal, and for the foreign product, when available.

ANTIMONY

There is little activity and quotations are nominally unchanged at 5.25c. per pound, New York, duty paid for wholesale lots for early delivery. Jobbing lots are about ¼c. per pound higher.

ALUMINUM

There has been a misunderstanding abroad regarding the quotation of the leading interest which is 28.20c. f.o.b. producer's plant, for virgin metal, 98 to 99% pure, in wholesale lots for early delivery. From other sellers who handle foreign aluminum the quotation is 24 to 25c. per pound, New York. The market is a little more active.

ORES

Tungsten: No improvement is reported and the market continues dead. Chinese ore is held at \$3 per unit for February-March shipment.

Molybdenum: Inactivity still characterizes the market with quotations nominal at 50 to 60c. per pound of MoS₃ in regular concentrate.

Manganese: No business is reported and no inquiry. Importations were again heavy in December at 59,248 gross tons, bringing the total for 1920 up to 601,437 tons, or close to the war record of 1917. Quotations are nominal at 35 to 40c. per unit, seaboard.

Manganese-Iron Alloys: Spiegeleisen is more active with about 250 tons sold and inquiries for 150 tons before the market. Prices are \$40 to \$45, furnace, but this has been shaded by some of the business done. There is no demand for ferro-manganese which is quoted on a basis of \$100, seaboard, but which could probably be obtained as low as \$100, delivered. Imports in December were 5424 tons, bringing the 1920 total to 59,204 tons, or the heaviest in several years. Exports are increasing with 55 tons credited to December.

Ferro-silicon, 50%, is quoted at \$92.50 to \$95 per ton, delivered, depending on the quantity involved.

Ferro-chromium, 4 to 6% carbon, is quoted and has sold at 17c. per pound of contained chromium.



T. A. RICKARD, . . . Editor

OWING to an epidemic of smallpox in Montreal, the Canadian Institute of Mining and Metallurgy will hold its annual meeting at Ottawa, at the date previously announced, namely, March 2.

PRODUCTION of gold in the Transvaal last year decreased to 8,153,625 fine ounces, this total being the lowest since 1910. The record output was 9,296,618 ounces in 1916. However, although the quantity of gold produced on the Rand and in the smaller districts of the Transvaal showed a decline, the value of the output, thanks to the depreciation in sterling exchange, was £44,640,420 in 1920 as against £35,383,974 in 1919 and £39,489,522 in the best previous year, namely, 1916.

COPPER, as an industrial metal, is not properly appreciated by the public, more particularly the consumers, who have been beguiled into employing substitutes of inferior quality. That is the text of a speech delivered recently by Mr. Ivy L. Lee before the New York section of the Institute. We are glad to give Mr. Lee's speech in full in this issue because we are heartily in sympathy with his argument. We only marvel that the producers of copper should have delayed so long to commence this campaign of education in behalf of the beautiful red metal.

WE learn, from a consular report, that Poland has been negotiating for the purchase of 300,000 tons of nitrate per annum on a credit guaranteed by the Chilean government. If this arrangement is put into effect, a large part of the stock on hand will be disposed of. It is obviously a logical course to encourage an increase in yield from farming operations in Europe by the annual shipment of a comparatively small tonnage of fertilizer from Chile, rather than to attempt to solve the European problem by sending large amounts of food-stuffs, and, by so doing, to encourage idleness.

WE endeavor always to give credit where credit is due and, to this end, include a statement giving the names of operating officials in the summary of company reports we publish from time to time. The great majority of such reports fail to give this information; as it is not easy to obtain, there are delays in publication and we are liable to make errors. Accounts of mining and milling operations lose their significance and value when the names of the operating officials directly responsible

for the results are not given. We hope that the secretarial staffs of all mining companies will see that their reports are complete in this particular.

OUR 'Discussion' columns contain a letter from Mr. T. T. Read, on famine conditions in China, in which he forecasts far-reaching economic changes, unfavorable to silver producers, unless prompt assistance is rendered. Mr. Read knows China well, but we are inclined to be less pessimistic. Our consuls in foreign countries are generally well-informed as to local conditions, and from this source we learn that the unusually mild winter has helped to lessen the distress, and also that the relief measures in hand appear to be adequate to cope with the crisis. About 10,000,000 Chinese, in isolated districts covering an area no larger than the State of Pennsylvania, are affected—only about 2½% of China's total population. Commercial Attaché Julean Arnold cabled to Washington on February 9 that the American Red Cross and other relief institutions are handling the situation admirably, and that Chinese trade will not be appreciably injured nor Chinese credit affected by the famine. Although these reports are reassuring, it is obvious that the condition cannot be permanently improved without a considerable outlay. Those who are able and willing to help should get in touch with the American Red Cross.

GERMANY is regaining her place as an industrial nation. Her exports are increasing by leaps and bounds. England is being flooded with German goods, a large proportion of which are being sold as of British manufacture, for the storekeeper lacks the nerve to tell the truth about their origin. As before the War, German goods are much cheaper than those manufactured in Great Britain or the United States. German instruments of precision are finding a ready sale in England, because the Teutons are ahead of their competitors in design, ingenuity, and workmanship; they are content to work for long hours, while the victorious British laborer is "resting on his oars". We recently examined a sample of German post-war workmanship—a pocket camera—a remarkably compact and complete piece of apparatus, of exquisite finish. Fitted with the well-known Zeiss lens, this camera fetches a high price in England, where it meets with no competition from any British-made article of the same type. As a Government official has stated: "Germany is still a perfect industrial machine, running at low speed it is true, but undamaged as yet in

its vital parts," she will yet show the world that "peace hath her victories no less renowned than war".

CONDITIONS in Mexico are described by Mr. William G. McAdoo, who has just been there, as "better than at any time since the revolution began ten years ago". In an interview he says that there is evidence on every hand of a return to peaceful activity and of renewed industrial progress. He met President Obregon and was most favorably impressed by his "fine common sense, great sincerity, and full comprehension of the serious problems confronting Mexico", one of which is the rehabilitation of the national credit. Mr. McAdoo lays stress on Mexico's dependence upon foreign capital for the development of her vast natural resources and suggests that "the only available market for capital and credit is the United States", wherefore it is essential that a good understanding be established with our country and with our Government. All those interested in mining in Mexico will look forward to the fulfilment of these friendly hopes; for ourselves, we feel that the de facto government has justified itself to a degree that demands official recognition from Washington, and we hope that such financial aid as is needed will be forthcoming as an evidence of our faith in the future of Mexico.

TISDALE township in Ontario levied a tax upon the reduction plants of several mining companies operating in the Porcupine district of Ontario, Canada. They claimed exemption on the ground that their mills were 'concentrators'. The question of liability to this taxation has gone through three courts, namely, the Court of Revision, the District Court, and the Appellate Division of the Supreme Court of Ontario. The first and the last of these decided in favor of exempting the mining companies from the tax under the Sub-section 4 of Section 40 of the Ontario Assessment Act. The gist of the decision, according to our friend the 'Canadian Mining Journal', is that "the term 'concentrator' is a term loosely applied by technical men to various kinds of mills in various localities, and is not a rigid term of fact having a strictly defined signification, and that a mill of the kind in question on these appeals is not disentitled to be termed a concentrator by reason of its combining chemical processes—the amalgamating or cyaniding, or both—with mechanical apparatus in separating values from mineral-bearing ore". If the mental processes of those responsible for this opinion are no better than the phraseology they adopt, we can have little confidence in them. One might as well exorcize the indigestibility from a doughnut as separate the values from a mineral-bearing ore. Is there such a thing as a non-mineral-bearing ore? Our contemporary, whom we have quoted, interprets the decision as meaning that "any part of the process of extraction of gold bullion from the native ore, or gold-bearing rock, is covered by the term concentration". If that be so, then the sale of stock in a mine by the promoter of it is a process of concentration whereby the gold in the pockets of the many is brought into the

pockets of the few. To 'concentrate' is to bring together to a central point; to increase the strength of anything by contracting its volume. To concentrate an ore is to bring together the valuable particles of mineral into a product so much less voluminous as to cheapen any further metallurgical treatment. It does not involve a change in the mineral by a chemical process, only segregation into smaller bulk. However loosely the term 'concentrator' may be used by technical persons, it does not connote the use of leaching or other chemical processes; on the contrary, it is restricted to the crushing, grinding, sizing, and bringing together, by mechanical means, of the desired parts of an ore while rejecting those not desired. The Appellate Division of the Supreme Court of Ontario has been fooled.

THE story of the Congressional junketing to China, Korea, and Japan has just been received. It consists of a special issue of 22 pages of the 'Congressional Record', reporting the speech of the Hon. Henry Z. Osborne, of California, in the House of Representatives on December 23 last. This priceless document arrived enclosed in a specially printed and sealed envelope, decorated with a facsimile of the gentleman's picturesque signature. The skill with which the accredited spokesman of the picnic switches from the business in hand before the House—the Pension Appropriation Bill—is worthy of note. "Our country", he was saying, "has in all its history been thoughtful and tender of those who have bared their breasts to the storms of war, who have taken their lives in their hands for their country, and it is well that this should be so. It is not, however, my intention to speak upon the subject of this bill further than I have already done. During the summer just past a number of members of this House and certain members of the Senate made a trip to the Orient", and then comes the picnic story, relieved at intervals by sub-headings such as "A Great Day at Hangehow", "Sight Seeing in Peking", "A Sunday at the Seashore", "Shooting the Hodzu Rapids", "A Regular Japanese Dinner", and similar ticklers to sustain interest. The House had listened to the account for about an hour when the honorable gentleman was advised that his time had expired. Having explained that he had only just begun, he was granted an additional half-hour in which to continue the recital. At its conclusion he was again reminded that there was other business before the House, but a further extension of time was made. After this no attempt was made to induce him to desist. The legislators, whom the daily press labels 'solons', learned the most intimate details of the pleasure cruise, and the honorable gentleman was allowed to continue his yarn to the bitter end—to the last day when, having been entertained royally on all sides and having seen all there was to see, Mr. Osborne spoke to a number of representative Japanese on the Californian question, and "with entire frankness", the result being that "some of our Japanese friends shed tears on saying good-bye". Crocodile tears, we venture to suggest, and not of the variety that many among us would be inclined to shed at the

thought of such official waste of time and opportunity in the House of Representatives, and of good money squandered in the printing, proof-reading, and distributing of a florid account of an excursion taken at the expense of the taxpayers. Mr. Osborne and his friends have 'put one over'; the publication and distribution of the account of their picnic 'rubs it in'.

The Price of Silver

When the market for a particular commodity is depressed it is wise to study the history of past fluctuations in order to obtain an inkling of the future course of prices. A glance at the record of the silver market may serve to hearten some of our friends who are in the dumps just now. We give herewith a chart showing the rise and fall of silver quotations during the last half-century and also during the last five years. It will be

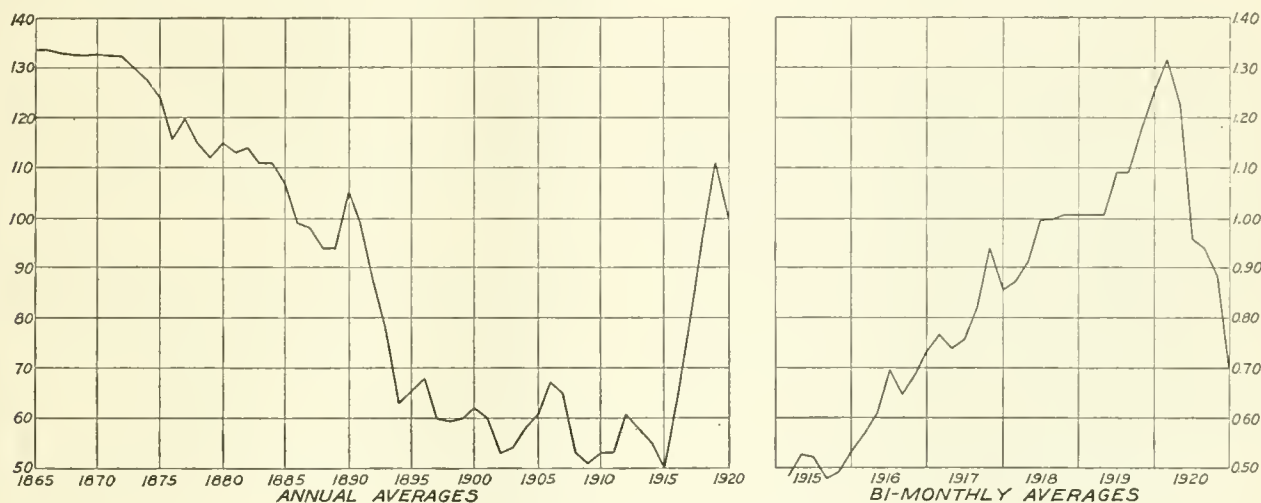


CHART SHOWING FLUCTUATIONS IN THE PRICE OF SILVER

noted that the points on the 'curve', as such jagged graphs are termed, represent the average price during the periods considered; thus the 1919 peak on the annual record is just above \$1.10, whereas in the bi-monthly record the peak is above \$1.31, this last representing the average for the months of January and February 1920. The annual record descends for 1920 because of the great decline during the latter part of last year. The highest price during late years for any one day was \$1.37 on January 13, 1920, whereas the lowest price was 59½ cents on December 10, 1920; thus in one year the market showed an extreme difference of 77½ cents per ounce, greatly to the perturbation of those engaged in the mining of silver ores. Since the beginning of the current year, a new low record has been made, the price receding to 58½ cents on February 18. All this refers, of course, to the international market for silver and not to the market for American silver, which has been stabilized at \$1 per ounce since the Pittman Act went into effect in June 1920. Returning to the bi-monthly averages, it will be noted how uniform was the rise during the four years after the slump in 1915, when the annual average was 50 cents, although on September 1, 1915, the price

reached 46½ cents, the lowest ever recorded. Taking the longer period, 1865 to 1920, it is evident that the average price was about 90 cents per ounce, which is slightly above the average for the last five years.

The Presidency and Journalism

The London 'Spectator', an exponent of sober British thought and the successor of the paper immortalized by Addison and Steele, speaking of President-elect Harding, mentions "one's pride in seeing a member of one's own particular profession rise to the occupation of as high a post in government as the world has to offer". We share that pride, although the frequent use of the impersonal pronoun would not come as naturally to us as to the editor of the 'Spectator'. He proceeds to say that "a journalistic training is a very good one for a President or Prime Minister", and the President of the United

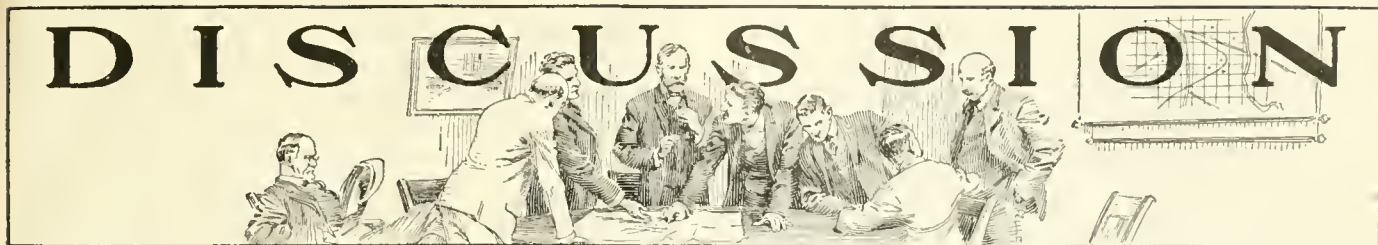
States is both. A journalist may be superficial, but so under modern conditions is any man who must give daily a dozen decisions on matters of first-class importance, as the President is compelled to do. "In an humbler way", says our respected contemporary, "this is exactly what a newspaper editor is constantly called upon to do. He is always having to take a line, very often to take it suddenly, and generally to take it on what is possibly imperfect information." Yes, indeed, the President must be a good deal like an editor, and having been one Mr. Harding will be prepared to face the music. "Appalling as it must at first seem, even to a journalist, to give decisions such as those a President must give daily, the matter is not half as overwhelming to him as it must be to a man without the journalistic training who is suddenly put into the highest office in the country. The President of the United States may be called upon in one and the same morning to give decisions which involve problems of currency, the rights and wrongs of Bolshevism, the Yellow Peril, the Negro Problem, the problem of the big Navy or small Navy, and so forth and so on. To most men these problems would be a nightmare. To the veteran journalist they are old friends." The gen-

tleman of 'The Spectator' evidently is sympathetic, a quality needed by editors in order to give them a wide interest in the affairs of men, but he makes a curious error in identifying the 'journalist' with the 'editor'. An editor is usually a journalist but every journalist is not, and has not the qualities fitting him to be, an editor. The latter is responsible for the policy of his paper, whereas the journalist is responsible only to himself, and can pass much of that responsibility to the editor who accepts his writings for publication. Mr. Harding has been both journalist and editor, so he has had experience both in making up his mind quickly on diverse subjects and in exercising the responsibility of giving utterance to the opinion of himself and of others. This ought to help him in the Presidential chair and it ought to bespeak for him the sympathetic consideration and friendly support of every editor.

Transportation by Motor-Truck

Legislation for the purpose of limiting the size of motor-trucks that may be operated over highways has been passed by a number of States in which the roads are said to be in danger of being ruined by heavy traffic. The result has been that manufacturers of trucks have launched enthusiastic propaganda intended to hinder the passage of further bills and to effect the repeal of those already on the statute-books. We concur in large part with the views of those interested in haulage by motor, but we venture to suggest that some of the literature being scattered broadcast would be more effective if it were not quite so violent in tone. Some of the arguments seem to appeal more to self-interest than to reason, whereas of reasonable argument there is plenty. The declaration that "the motor-transport industry must not be ham-strung by iniquitous regulation", because the burden will finally fall upon the "ultimate consumer", in the shape of increased cost of finished products, is too trite; it savors of insincerity. Grave concern for the unhappy consumer is too often prompted by an anxiety as to one's own financial welfare. The immense size of the industry of motor transportation is rightly emphasized; about 900,000 trucks are engaged in hauling sundry kinds of freight in the United States with a considerable reduction in cost over former methods of performing the same work. The special field for the motor-truck is the 'short-haul', and for such work it is welcomed by the railroads; although there is doubtless an intermediate zone within which the railroad and the motor-truck compete. It is contended that on hauls up to 175 miles the 1½-ton motor offers more economical transportation than the railroads, provided fairly good roads are available. The maximum radius for a 6-ton truck is about 350 miles. The greater ultimate efficiency of the heavier truck is indicated by the comparative cost, including depreciation, labor, and maintenance, for operating machines of different sizes. Reliable data show that, whereas under favorable conditions a 1½-ton truck can move freight at an average cost of 17 cents per ton-mile, a 3-ton truck can do equivalent work at a cost of

12 cents, and a 7-ton machine can duplicate the performance for approximately 7 cents. The increased efficiency of the truck as compared with the railroad arises largely from the fewer number of times freight must be handled when either the point of origin, the destination, or both are not on a railroad spur or side-track. Motor-haulage is particularly successful in the mining industry. Many valuable properties, situated at a distance from a railway, do not promise traffic of sufficient volume to warrant the construction of branch lines. Under such circumstances a well-built highway and a fleet of trucks frequently affords the ideal means for hauling supplies to the mine and the products of the mine back to the railroad. As compared with teams, which offer the only alternative, the advantage is always in favor of the truck, provided a road can be built on a reasonably moderate grade. The investment is greater if trucks are used, but the gross cost per ton-mile will be much in favor of motor-haulage. Trucks, both large and small, are used to excellent advantage at many mines for moving machinery, cement, gravel, timber, and other heavy supplies from place to place on the property. However, the admitted utility of the truck is not of itself a valid argument for permitting excessively heavy machines to ruin the public roads. The scientific opponents to the prohibition of large trucks have endeavored to prove that size is not the factor determining the amount of wear on the road. Tests conducted by the U. S. Bureau of Public Roads indicate that impact of the wheel, rather than the gross weight of the loaded truck, does the damage. In other words, the 'unsprung' weight must be minimized; this weight depends in part on the design of the individual machine, and the ill effect is mitigated to a large extent by the substitution of pneumatic for solid-rubber tires. It is obvious that steel tires, so frequently used for loaded trailers, have no place on any highway. It has also been demonstrated that a normally loaded 3-ton truck operated at 20 miles per hour will do more toward destroying a road than a similar 7½-ton vehicle traveling at 10 miles per hour, which suggests another direction for regulative action. Few of our roads were built to withstand the traffic of heavy and rapidly moving loads; the strain has been too great, and the road-bed, not the surface, has given way. It is said that 70% of the trouble has arisen as a result of defective drainage and weak subsoil. Some of the roads being built at the present time are constructed scientifically with adequate sub-grades, built to withstand the passage of loaded trucks. Unfortunately, however, politics is mixed with road-building, the result being an effort to build two miles of road for the price of one. The surface is handsome; the foundation does not show, and is therefore given scant attention. Eventually there should be a system of good roads connecting all important points; in the meantime we commend a reasonable compromise between the enthusiasts who object to any regulation or limitation, and the zealous law-makers who see no way to preserve the roads other than by prohibiting the heavier trucks under any and all conditions.



Institute Affairs

The Editor:

Sir—I venture to suggest that the lamentable condition of the finances of the Institute may be traceable, to a considerable extent, to a cause to which little attention has been paid. The directory contains the names of over 400 members who serve on over 40 committees and sub-committees. The list includes a number of eminent men, whose professional status and wide experience is beyond question. The names of others are unknown to me. Several of the committees have been appointed "to obtain papers of high merit for publication by the Institute". As a member, I would be glad to know how these committees are formed. By whom are they chosen? It appears to me that they have, in many instances, failed in their duties.

I attended the New York meeting in February 1919; and being especially interested in milling methods I hoped to glean something of worth in the discussion of a paper on 'Fine Crushing in Ball-Mills'. The subject was a live one. The application of the ball-mill to modern ore-dressing work involves vast expenditures; therefore research that would lead to the introduction of even trifling economies would be welcome. Although some misapprehension with regard to ball-milling had been cleared away, the lack of definite conclusions, which should be easily obtainable and which would establish the superiority of certain types of mills for certain work, was evident. The facilities at many of the university experiment stations appeared to me to be such that valuable data would result from impartially conducted research along practical lines.

As an effort to elucidate any of the problems of ball-mill work the paper itself had been a distinct disappointment. A title such as 'Fine Crushing in Ball-Mills' inferred a broad treatment of the subject, incompatible with the fact that the tests were made with, and the results only applicable to, a single type of conical mill. By not correcting the title the committee encouraged the idea that a mill of special design could be used to determine data on ball-milling in general, and so ensured the shelving of one of the most important questions yet to be determined, namely, the comparative efficiency of ball-mills of different shapes.

The paper consisted of 46 pages of matter. Much of this was in the form of an imposing array of complicated and involved mathematical calculations, which must have appeared to an engineer to be of little or no practical significance. The author of the paper unconsciously con-

firmed this conviction when, after an illuminating display of theoretical reasoning on the question of ball-mill speed, he naively added that: "In actual practice it may be found that more effective crushing can be done at some other speed"!

In order to emphasize the unusual nature of some of the work given publicity, attention may be drawn to the fact that the 'problem' was to crush a comparatively fine gravel (minus $\frac{1}{4}$ in.) to 200-mesh, and for this purpose a mill of 8-ft. diameter was chosen. In the first test described a load of 14 tons of steel balls of 5 in. diameter and smaller were used to grind a feed of 3.66 tons per hour. The result of this test was that 2.24 tons of 200-mesh material was "actually produced". The feed was then increased and the usual chart drawn. For reasons that no ordinary enthusiast could appreciate, the tests were stopped when a feed of 18 tons per hour had been reached. The author's comments were illuminating: ". . . the tonnage of 200-mesh material produced varies directly with the tonnage fed to the mill. There is undoubtedly some limit to this relation, but there seems to be no indication of it at 18 tons per hour. Some of the conclusions drawn from the test are", we were told, "(a) the ball-mill is naturally a machine with a very large capacity; (b) if it is not possible to deliver a large tonnage of original feed to the mill, a closed circuit should be provided . . ."

The "conclusions" left me gasping. The first I classed among milling platitudes; and, as regards the second, one naturally asks: "If it is possible to deliver a large tonnage of original feed to the mill—and what is there usually to prevent it—what then?" And this is the result of a test "to determine the crushing efficiency of the ball-mill operating in open circuit"! There was no discussion at the meeting—those present with a knowledge of ball-milling were speechless apparently. The 'Milling Methods' committee consists of over 60 members. Is it really a committee; and do the members, collectively or individually, use their judgment in these matters? Do they insist on brevity, and do they point out to intending contributors the necessity of commencing their investigations where others have left off?

A few years ago an engineer of wide experience and some standing in the profession took up his residence in New York. Being a member of the Institute, a specialist and a writer in a particular branch of metallurgy, he courteously placed himself at the disposal of the chairman of the special committee on that subject. A formal acknowledgment of the offer was received, and there the matter ended. The committee was duly 'picked'. About

60% of those nominated were, according to their designations in the directory, not specialists; several were unknown as having contributed in any way to the technology of the subject. Two members of the committee were connected with a commercial undertaking vitally interested in the sale of machinery in that particular field; these could not be expected to give an impartial decision; although as a *quid pro quo* for a certain amount of advertising in the Institute's magazine their appointment to the committee was doubtless sound business policy. We need more limelight on the precise methods adopted in appointing committees of this nature. As a subordinate trustee of some of the money paid in dues, such a committee should be selected on the basis of special qualification; and, having accepted the nomination, every member should realize that the position carries obligations as well as honors.

After several years of membership of the Institute I have to go to a library to consult the Transactions. Owing to the high cost of rent and the levies on excess baggage I have been obliged to throw away my copies of the proceedings as received. Mining engineers would fain reduce their books of reference to small compass, but in this one instance they must take all or none. With regard to the publication of the monthly magazine, I am in entire accord with those who favor its early decease. A mining engineer of high standing on the Pacific Coast, in discussing this question with me recently, said that because of the necessity of keeping in close touch with all phases of development in the application of mining and metallurgical methods he followed a plan of scanning all publications as received, marking those articles which deserved detailed study or which should be filed. To him, as to many others, 'Mining and Metallurgy', as a source of information, has proved barren. It is worse than useless, for much time and labor is spent, and temper is occasionally lost, in the search for what is never there.

I suggest the election of advisory committees pledged to see that the publications of the Institute are condensed, by proper editing if necessary, to a reasonable bulk, or by the exclusion of the obvious, the absurd, and the uninformative.

A. W. ALLEN.

San Francisco, February 10.

The Editor:

Sir—The following points appeal to me, as a member of the Institute, as being pertinent to the discussion precipitated by the recent 'voluntary' assessment of \$10. In spite of the recent definite trend toward its enhanced importance in the task of making ends meet, a 'ten-spot' is still a small item. Nevertheless sensible engineers as well as business men are asking themselves today whether or not they are approaching, within reasonable limits, the maximum efficiency in even the smallest expenditures. It is the privilege of each member to inquire whether the funds of the Institute are spent effectively and economically; and he is further concerned in the question of whether or not he is getting just what he wants from the

Institute. In the end his expenditure is just as inefficient if he gets a product that is of no use to him, even though the operation of preparing that product be in itself 100% efficient, as if the actual process of production were wastefully performed. To many the mere fact that a deficit impends suggests the possibility of inefficiency or indifference somewhere in the administrative organization. Moreover, the recent assessment and the accompanying explanation are far from reassuring. In the first place, the deficit is given as approximately \$20,000, whereas \$10 collected from each of 9446 members would amount to \$94,460, thereby leaving a surplus of some \$75,000. Doubtless it was suspected that some would decline to pay; apparently then to make sure of having enough, \$10 was decided upon as a convenient amount. It is fair to say that this haphazard method of financing seems ill advised and that it is not calculated to gain the confidence of the members in the competence of the business administration.

The method of procedure is open to criticism from another point of view. A few doubtless paid without giving the matter a second thought; a good many considered the matter and decided to pay with a feeling of resentment because they felt slightly imposed upon in paying four times their fair share; and many concluded, as a matter of principle, not to pay, in spite of a decidedly uncomfortable feeling that their share was being paid by some other member. The average member guards jealously the privilege of 'holding up his own end'; but at the same time he dislikes to feel that advantage is being taken of his desire to do the square thing. If the required amount had been pro-rated among all the members, I venture to say that there would have been few delinquents and a great deal less hard feeling.

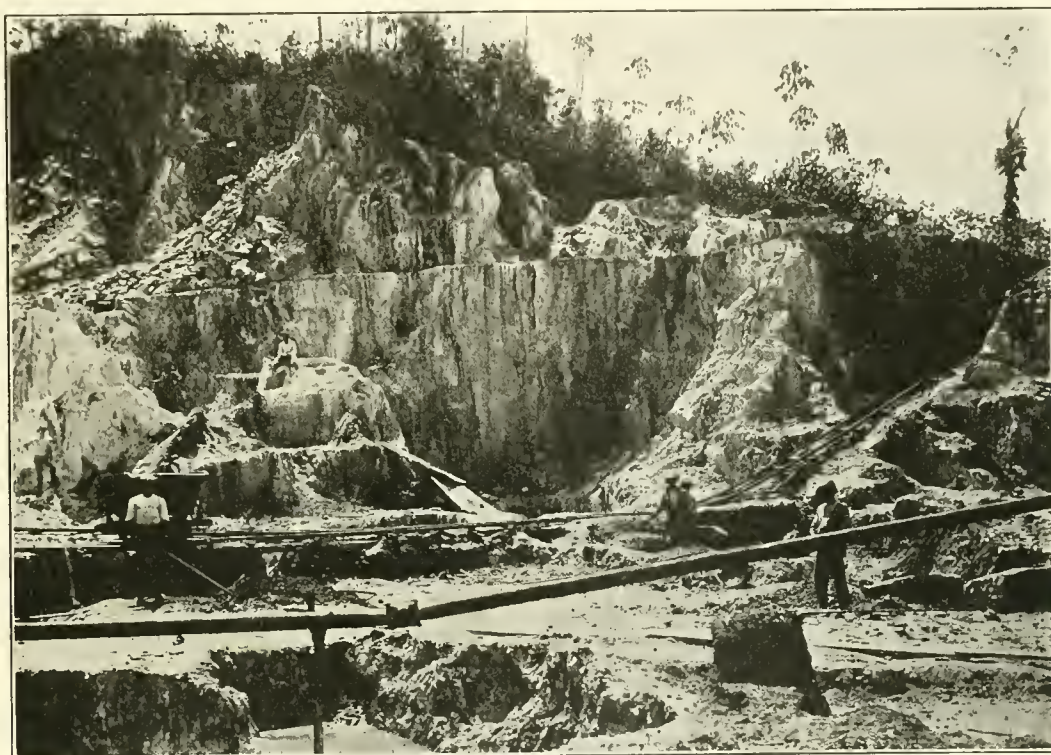
The statement made by the directors offers the explanation that the deficit arises because it is deemed unwise to curtail the activities of the Institute. It seems evident, however, that the plan of publishing 'Mining and Metallurgy' was launched at a time when the finances of the Institute were in a parlous state. Anyone with the experience in publishing that Secretary Stoughton has had must have known that the enterprise would be costly, and presumably he advised the directors of the fact. A great many members feel that the magazine in its present elaborate form is entirely outside the province of the Institute; but whether it is desirable or not, it is reasonable to enquire why its publication was authorized when a financial deficit was likely to ensue. The whole thing suggests a laxness or dissipation of administrative responsibility that is at least open to investigation.

Volume LXII of the Transactions, containing some 800 pages, was devoted to papers relating to the iron and steel industry, most of them discussing sundry phases of specialized processes, none of which are of the most remote interest to the 'non-ferrous' metallurgist or the average mining engineer. Is this symptomatic of a lack of discrimination in choosing the material to be printed in the Transactions? Should they be made a record of

exhaustive researches on subjects of value or interest to not more than a few dozen members, excellent though the papers themselves may be? Or should the policy be to publish only the best articles dealing with real progress in the arts and sciences connected with mining and metallurgy.

The main issue, of course, is not the payment or non-payment of the \$10 assessment. That is a mere incident. The question is whether or not, in the effort to increase membership and to gain public influence and prestige, the basic purpose of advancing the profession as a profession has not been submerged. In this connection it may be pointed out that the organization of the Federated American Engineering Societies, of which the Insti-

knows of its whereabouts. But here is a photograph of one there that is over 200 ft. wide, that has been worked to that width and to an equal length along its course. This, in short, is the open excavation that has yielded the 60,000 tons of ore from which \$135,000 has been recovered by plate amalgamation only. Everything in sight is payable ore, in the floor, in the face (which is about 100 ft. high) and on both sides, for in neither direction have unpayable boundaries to the body yet been reached. There is no waste-dump. All material broken has gone through the mill. Below the latter is the tailing, which has been demonstrated by hundreds of tests to contain better than \$1.50 per ton. Ahead of the excavation and along the line of the orebody scores of pits and open-cuts



THE TEATS QUARRY IN DUTCH GUIANA

tute is a member, has undertaken to concentrate and direct the energy and influence of the engineers of the country with respect to social, industrial, and political problems, thereby leaving the individual societies to perform their primary function, which has to do with progress in technical and scientific affairs.

San Francisco, February 11.

A. B. PARSONS.

Mining in Dutch Guiana

The Editor:

Sir—Mr. Rogers' letter in your issue of January 29 is interesting. Though he claims to hail from New York, he displays the Missouri temperament, and evidently wants "to be shown". All right! I will try to enlighten him.

The two-foot vein of \$2.50 ore which he discovered at the time of his visit, and which no one previously had noticed, has apparently been lost since then. No one

have been dug upon it for a distance of over a mile, and all of them exhibit the same character and quality of material as has been taken from the quarry. This means at least eight million tons above the floor and probably much more, for the mineralized zone has a width in place on the surface of 1200 ft. Right at the quarry it is 500 ft. wide.

As to the profits of the undertaking, it is sufficient to say that the owner of the property has invested no capital in it. It has paid for and equipped itself from the start and has yielded a surplus over all costs. It is not for sale.

As to climate and sanitary conditions, it is perhaps possible to find a few places on the planet with a death-rate of less than 14 per thousand, but not many. And why should one become excited over an annual precipitation of 80 inches? In the Scotch coal and iron districts the rainfall rises to 130 inches, but they manage to keep the water out of the shafts, or to pump out what slips in.

The experience at Panama proved that the West Indian black laborer, when properly handled, fully earns his small wage. The Surinam negro workman is of the same racial stock; he will do better than the average Mexican peon in Mexico.

It is five years or more since Mr. Rogers was in Dutch Guiana. Much can happen in a period of that length. It is rather unusual to condemn a region on the basis of observations made so long ago.

Denver, February 1.

THO. F. VAN WAGENEN.

[This gives us the opportunity to correct a typographic error made in the printing of the letter from Mr. Rogers. His correct initials, as is well known, are A. P., not A. R. —EDITOR.]

The Broad Lode Hypothesis

The Editor:

Sir—In your issue of January 29, Mr. F. L. Sizer enters the discussion on the Utah Consolidated v. Utah Apex law-suit, which has aroused more interest in the hypothesis of a broad lode than any previous litigation within my recollection.

The suggestion in the last paragraph of Mr. Sizer's letter ("The only real cure for the evil of apex litigation will be the adoption of the square location") is in line with suggestions made by me, while in the Government service and at various other times. I am glad to see this phase so opportunely injected into the discussion, as it is evident that there is pending the introduction of a bill in substitution for H. R. 12275, February 25, 1916, legislation looking to a revision of "Sections of the Revised Statutes of the United States relating to the location of mining claims on the public domain, and for other purposes." The less said of the above mentioned H. R. the better.

In somewhat more detail, I would suggest that the 20-acre unit, lode or placer claim, be retained; that where the public lands have been surveyed, these units conform to the public-land surveys or half of the 40-acre legal subdivision, north-south or east-west, as best suits the strike of the lode or the course of the gulch, as the case may be; that, the dip of the lode, inferred or disclosed, be protected by locations made to cover same, in lode mining, off the dip from the apex claim. It may be desirable to limit such, protecting locations to one, two, three, or more, parallel claims, the number to be regulated by the dip of the lode or deposit.

These locations would be bounded by vertical planes on all sides. Precedent for such suggestions is found in the older settled sections of the country in which the mineral land laws do not apply. For instance, the Lake Superior iron and copper mines, would, had they been located under Western mining laws, have afforded some perplexing legal problems, even more so, I believe, than the most perplexing yet brought to court in the West. It would be interesting to look into the situation as bearing on some of the iron deposits of the Gogebie iron range of Michigan and Wisconsin. The copper mines of Michigan

afford the suggested necessity for "three or more" protecting locations "off the dip". There, with the dip of the "beds" at 35° to 40°, the mines have been worked to depths of 8000 ft. on the dip.

In the West, Bisbee operators took the bull by the horns. Have we any long drawn expensive apex litigation coming from that famous copper district?

Revision of the mining laws is imperative; it is vital to the development of the mineral resources of the West. Present locations and patents could be adapted to the proposed plan, in a majority of cases, where intervening locations are not involved.

The present rules and regulations of the General Land-Office are breeding dissension, quarrels, and law-suits, owing to the permitting of agricultural entries on classified mineral-lands, in fact, such are well under way in this State. That it has not become more pronounced is due to the lethargy of the mineral industry for the past several years, and, in the case of Montana, to the boosting of "dry-land farming", advertising by the railroads, the land agents, and the press, along agricultural lines. The drought of the past three or four years has had a discouraging effect on such agricultural entries, however, and, in the draughting of new mineral land laws this situation should be fully considered and the disposition of the lands so provided for as to prevent the clashing of varied interests.

With the turn the discussion has taken, the Utah Consolidated v. Utah Apex case may be of everlasting service to the prospectors, operators, and investors of Western mining enterprises.

L. S. ROPES.

Helena, Montana, February 3.

Silver Prices and the Famine in China

The Editor:

Sir—The relation between the probable future price of silver and the widespread and serious famine that exists now in five provinces of Northern China may not be evident at first glance, but a very real relationship does exist.

China and India have always been the parts of the world that absorb silver with almost the avidity with which a sponge takes up water; therefore the social conditions in these countries have a marked effect on the price of silver. In its efforts to stabilize the value of the rupee, the Indian government has accumulated a large stock of silver, and it would appear that China must be the mainstay of the silver market, for the immediate future at least.

Unfortunately, from the unusual series of crop failures, five provinces of Northern China, having a total of nearly 90,000,000 population, are in the grip of the greatest famine ever known. More than one-half the people of these provinces are seriously affected and it is estimated that some 15,000,000 will die unless food is furnished them. The humanitarian appeal to help the suffering is so evident that I do not need to refer to it, but, I should like to point out that the desirability of render-

ing aid, so far as we can, might be looked upon as wise business foresight as well. If the people in this immense area are so weakened by starvation that they are unable to plant crops this year, presumably famine conditions will be even more widespread next year and the whole of Northern China will be impoverished.

The railways of China have outstanding over \$300,000,000 worth of bonds, most of which are held by foreign investors. If, as a result of the conditions now existing, business so declines that the railroads will not earn interest on their indebtedness, the security of these investments will be threatened and it is obvious that in general the buying power of China, and consequently its support of the silver market, will be greatly decreased.

I beg to make the suggestion, therefore, that silver producers would do well to realize that they have an interest in the problem of furnishing aid to the famine areas in China.

THOMAS T. READ.

Washington, February 11.

Educating v. Drop-Forging

The Editor:

Sir—I have read with some interest Mr. Coghill's article on this subject. Since you have devoted space to editorial comment upon it, I assume you welcome further discussion.

You are wholly right regarding the inadequacy of the criteria submitted, for there is no question but that at the time the men to whom Mr. Coghill refers graduated from college, the mining curricula at both institutions, mentioned by name, was quite similar to that of most other mining schools. I do not believe that these men, in particular, were compelled to be 'educated', but could just as easily have been 'drop-forged' had that been their tendency. I confess I do not see the reason for selecting just one Eastern school as an example of all of them. That is the only one, to the best of my knowledge, that requires an undergraduate course before admission to the School of Mines. The others educate men also without this requirement. In fact, I believe both the Massachusetts Institute of Technology and Harvard used a similar plan at one time, but have since abandoned it.

Those of us who have given much attention and real thought to mining education know that it is directly up to the student, and that in the mining schools of the West, particularly in the North-West, there is nothing to prevent the student from acquiring as many of the 'humanities' as he wishes, as well as the prescribed course if he has the time and money for it. I venture to say that no Eastern schools offer a broader four-year program than those offered here in the North-West. Further, it is a fact that toward the end of the first decade of the 20th century the four-year program was standard in the East, and today but one school requires anything different. At the State College of Washington, which may be taken as typical of Western schools in general, the student has a definite program to complete in four years, in which an endeavor is made to include some of the cultural subjects.

The student may, if he wishes, here as elsewhere, spend five or six years, as in the East, and devote all his additional time to the so-called cultural subjects. No school of mines, however, is warranted in compelling him to take this extra time. Many men would be deprived of the opportunity of valuable education were they compelled to spend six years in getting it. The student is usually more or less mature upon matriculation. He may justly ask that he be allowed to complete his courses in four years if he so wishes. Mining education would be in sore straights indeed were all men, regardless of age, ambition, or opportunity, cut to the same six years' course.

In the case of the schools referred to as "isolated", I am certain that there are great universities near-by where the students might take a preliminary course if they so desired. 'Drop-forging' is not then a function of East or West. 'Who's Who' or 'Who's Not' may be found in as many of the institutions in the East as in the West. This does not mean that the major subjects must not be taught in such a way as to educate properly, but my point is that many men become a credit to their profession who take the regular four-year courses in our schools of mines, be they located in the East or the West. It is undoubtedly true that it may benefit a man to remain longer at college.

I feel just as much concerned as Mr. Coghill about too much of an attempt to 'drop-forge' men, to use his own expression, but I do not feel that this is inherent in our Western schools of mines, and I think that a complete investigation by Mr. Coghill would have shown the same to him, although for students who can afford five or six years in college we would most heartily recommend part of an academic course before taking up the major subjects in mining, but this does not imply that no one should be allowed to take the straight four-year course, or that Western mining schools should be abolished, because they do offer such a course.

L. O. HOWARD.

Pullman, Washington, February 8.

Tin Exports From Malaya

The total tin ore exported from the Malay Peninsula in 1919, according to a consular report, amounted to 741,970 piculs valued at \$32,247,444, compared with 768,157 piculs in 1918 valued at \$41,623,383. The following table indicates the movements of Straits tin shipments since 1910, quantities being expressed in tons of 2240 lb. each:

Years	United Kingdom	United States	Continental Europe	Total
1910	35,047	12,915	6,643	54,605
1911	33,505	15,375	6,288	55,168
1912	33,482	18,238	7,230	58,950
1913	35,158	18,107	9,105	62,370
1914	35,652	19,240	8,306	63,198
1915	22,753	32,240	11,006	65,999
1916	25,011	28,108	8,481	61,600
1917	16,304	13,457	6,190	*35,951
1918	(†)	(†)	(†)	(†)
1919	19,592	27,135	4,111	50,838

*January to June, inclusive.

†No official records available owing to Government restrictions on publications of trade returns.

The picul is an Oriental commercial weight of 133½ lb. in the Straits Settlements, and 140 lb. in the Philippines.

Elementary Facts About Oil

By P. B. McDonald

The attention being paid to oil, in connection with industrial and international affairs, makes it appropriate to recall sundry elementary facts of which engineers who have specialized in metals have, perhaps, a hazy conception. Webster says that oil belongs to a large class of unctuous combustible substances that are liquid, or easily liquefiable on warming, and soluble in ether but not in water. An essay on oil by Sir E. Ray Lankester has been included in 'Secrets of Earth and Sea', published by the Macmillan Company.

Sir Ray remarks that mineral oils and waxes possess a great advantage over vegetal and animal oils in that they do not become rancid; they do not decompose as a result of the action of bacteria. A further difference between the paraffines and the vegetal and animal fats is that the paraffines do not combine with alkalies and other bases to form soap; nor can they serve as food for man or animal, because they are not acted upon by the digestive juices. These facts, of course, are known to the Standard Oil Co., which makes and sells a preparation called 'Nujol', but perhaps they had escaped the attention of the average engineer not especially informed on matters relating to characteristics of oils.

Natural bitumen, as the Romans called it, has been known and used from ancient times. The term, in its widest sense, includes natural gas, the various petroleum, and solid asphalt. The Egyptians used asphalt for embalming their dead; the ancient Assyrians used it ('slime' in the English version of the Bible) in place of calcareous mortar for building; and in Europe today it is used as a 'damp course' in walls built of brick. In addition to the famous lake of pitch on the island of Trinidad, there is a rich deposit in Switzerland, from which the asphalt used for making roads is obtained. Harry Franck, in his recent book on the West Indies, describes the simple way in which asphalt is dug from the firm surface of the 'lake' in Trinidad, and how by next morning the excavation is again filled.

The ancients noticed natural springs of liquid bitumen (petroleum), some flowing freely like water, that would take fire and burn for long periods, and were described as fountains of "burning water". The Greek word for naphtha was applied in early times to petroleum issuing from the ground in South Russia and Persia, in which regions today are to be found some of the world's most important oil-wells. The term 'naphtha' is still applied to the more volatile hydrocarbons obtained by the distillation of petroleum, coal-tar, wood, and shale. During the Middle Ages and the period of exploration that followed, records were made of springs of inflammable oil in Japan, China, Burma, Galicia, Italy, England, and Central and North America. Mineral oil, until the middle of the 19th century, was valued chiefly as a medicinal application. 'Seneca oil' and 'American medicinal oil' being widely sold as an embrocation. This, of course, was before the time of the great John D. Rockefeller, and

when whale oil, relied upon for illuminating purposes, was comparatively expensive.

The name 'petroleum' was introduced by Professor Silliman in 1855, when he reported upon the 'rock oil' or 'petroleum' of Venango county, Pennsylvania. The Pennsylvania Rock Oil Co. bored for oil in 1854; and after several unsuccessful attempts the tools dropped into a subterranean cavity at a depth of 69 ft. On the following day the well was found to have struck oil, with a yield of 25 bbl. per day. Even so late as the year 1900 only 64,000,000 bbl. was produced in this country, a trivial amount as compared with the 250,000,000 bbl. of annual production in recent years.

The early prejudice against the use of petroleum as an illuminant was due to its offensive odor, which perhaps gives emphasis to the theory of a fish origin advanced by some geologists. The ancient Romans burned petroleum from Sicily as an illuminant, but perhaps their sense of smell was not so sensitive as that of our people. Petroleum was discovered on the western slopes of the Alleghanies in the early part of the 18th century, during the boring of brine-wells, but it remained for a Dr. Brewer, in 1853, to suggest its use as an illuminant and to develop a method of purifying it.

Oil has become so significant a factor in economic calculations that governments are debating how to outwit one another in capturing the world's output. If, as Herbert Hoover advocates, American capital should seek permanent outlet abroad to offset the inequalities affecting our balance of trade with some foreign countries, it would seem that speculation in oil properties would offer an excellent field.

Repairing Iron Vats

A method of repairing cyanide vats that deserves a wider publicity is described by C. Flury, in a recent issue of the 'Journal of Industrial & Engineering Chemistry'. The bottom of a 5.5-ft. by 22-ft. leaching-vat contained numerous holes, and some parts were so badly worn that a needle could be passed through without effort.

At first the leaks were caulked with coal-tar-soaked cotton waste, a method which proved to be inefficient. Then a 2-in. cement bottom was laid on the inside of the vat; but pressure variations during charging and discharging, causing bendings of the bottom, broke the cement layer. This observation led to the construction of a more flexible bottom, built as follows: Over the whole defective bottom was laid a 0.25-in. asphalt layer, covered with canvas which consisted, in this case, of old filter leaves. Care was taken that the canvas was pressed on the asphalt while the latter was still hot, in order to secure a close contact. Finally the canvas was covered with asphalt for a thickness of 0.25 inch.

After 24 hours the vat was filled with water, held under water-pressure for 72 hours, discharged, filled again, and held under pressure again for 72 hours. During this test not the slightest leak could be observed. The total repair cost amounted to about \$92.

Copper Metal From the Consumer's Point of View

*During the 25 years between 1895 and 1920, the most notable period in the history of copper, there has been a lack of scientific attention on the part of producers of copper to the ultimate disposition of the metal. Today, however, I believe, not only producers of copper but the men who direct the rolling-mills in which copper and its alloys are shaped for the consuming market are beginning to manifest an interest in the final resting-places of their products.

The research that I have mentioned had to do in the main with the consuming end of copper. We have known all about the copper production and methods of refining and selling from the outset, these being matters of record. We have also known all about the methods of the rolling-mills, or 'fabricators' as they are called, and the proportions of copper, brass, and other alloys they produced in the standard finished materials such as wire, sheets, rods, and tubes, because these things, too, were matters of record; but at this point we found that records ceased, that no man or group of men had more than a vague idea of the proportionate consumption by industries.

Copper is no different from any other commercial product in that the amount you can profitably produce depends entirely on the amount the public will consume, yet we were unable to find that at any period in copper history any serious effort had ever been made by either producer or fabricator to study the consumer; or, what is more important, to educate him to the great superiority of copper and copper products over other commercial metals. And so copper and its alloys have gone on the market with the handicap of an initial cost higher than the metals in competition with them and without any concerted effort to justify this cost by informing the consumer of the great advantage and ultimate saving accomplished by their use.

It is a great tribute to copper and copper products that up to the time of the War they were able to more than hold their own in such circumstances. What has happened since then is well known. With Europe practically shut out of the American copper market through lack of funds, our copper industry has been obliged to turn to domestic consumption for existence.

And what has it found? It has found the market glutted with substitutes for which a tremendous demand has been created as a result of advertising, clever publicity, and intensive promotion efforts. It has found a public thoroughly well educated in what merit these substitutes possess, and keenly disposed toward them be-

cause they answer immediate requirements and are obtainable at a much lower cost than copper and copper products. They find that the public, generally speaking, knows little about copper, although it is the oldest of commercial metals. Of what use is it to have a superior article if the public doesn't know it is superior, and that in all its standard uses it works a large saving because of its everlasting life and absence of upkeep expense, to say nothing of its salvage value.

And so I feel that I can say that the present plight of copper is due in a large measure to certain neglects of the past. A substantial part of the losses in export business might be made up by an increased domestic consumption if the public knew the merits of copper and its alloys. Naturally, I am a strong believer in public education; I have seen too many instances of its success in business to have any doubt of its efficacy where it is employed in the interest of a product that has merit.

Twelve years ago aluminum was a drug on the market. Among retailers of kitchen utensils it was known as "lemon metal". Aluminum was used for about a quarter of 1% of the utensils in use in the United States. Under improved processes of manufacture a good grade of aluminum was produced, but so evil was the metal's reputation with housewives that it could not be sold. So a campaign of education was planned and carried out. Today aluminum is used for more than 50% of the utensils in this country, and the demand for it is steadily increasing. Copper has been almost entirely driven out of American kitchens, being used in the manufacture of only 6% of the utensils in use.

Who ever heard of Armco iron until the American Rolling Mills Co. began to placard the country with its merits, to get its message into every manufacturing establishment and every home in the country. In 1914, when its publicity effort began, its output was 25,000 tons per year. Today the output is 200,000 tons per year, and this will be increased as soon as additional mills, now being built, are completed.

Then there is Monel metal, an alloy that contains about 28% of copper, from which I am told it gets much of its merit. In the first eight months of its campaign of public education the International Nickel Co. more than tripled its sales of Monel metal.

All these metals are sold in direct competition with copper and copper products. It would be idle to deny that they have made serious inroads into fields once dominated exclusively or almost entirely by copper and its alloys. I could go on indefinitely in telling you about the results of these campaigns of education, but you probably are already familiar with many of them, so I will just direct your attention to the fact that substantial results have followed those launched in the last few years by the New Jersey Zinc Co., the American Face

*Speech of Ivy L. Lee, adviser in publicity and public relations to various corporations and interests, including the Copper and Brass Research Committee, at the annual meeting of the New York Section of the American Institute of Mining and Metallurgical Engineers, held at the Machinery Club, New York, on February 2, 1921.

Brick Association, the California Fruit Growers' Exchange, the California Raisin Association, and the Brazilian coffee growers.

In our investigation we were unable to find any other industry that had allowed the product on which it depended for existence to run along by itself. There has been no scientific effort made to stimulate a demand for the metal and its alloys among natural consumers, to create new markets, or to protect the metals industries in which they had become entrenched by their sheer worth.

Years that have been marked by large increases in copper consumption have always been years in which the demand was created by some influence entirely outside the industry itself. In 1895, the middle of a notable decade in copper history, the production of copper in this country was only 380,000,000 pounds. Then came the sudden expansion of the electrical industry, the establishment of the long-distance telephone, and the extension of electric-railway systems in all parts of the country. This was followed by many new industrial enterprises, the automobile industry being a conspicuous example.

Then came wars, the Spanish-American, the Boer, the Russo-Japanese, and the Balkan wars, with their heavy demands for copper and copper products. Between 1895 and 1916, copper production jumped from 380,000,000 to 1,928,000,000 lb., and in 1918, under pressure of the demands of the world war, the production from domestic ores alone was more than 2,500,000,000 pounds.

Of course, you gentlemen know that such expansion would not have been possible on the basis of demand alone. It was made possible by the advance in mining methods for which some of you here are probably in part responsible, permitting the profitable working of low-grade ores, and by the discovery of new copper deposits.

I will not go over the wide range in prices of copper during the 25-year period that I have mentioned. As you know, copper prices always go up with increased demand! It is enough to say that after passing through various vicissitudes, copper got under way nicely at the beginning of 1920, at about 19c. and wound up the year with plenty obtainable between 12½ and 13c., but with practically no inquiries being made.

With the expansion of electrical enterprises in this country and the rehabilitation of European finance, the demand for copper and copper products should automatically reassert itself. To leave a great industry dependent on such spasmodic needs, and constantly facing the menace of such experiences as copper has gone through in the last year, however, is poor business. It seems to me to be a particularly ill-advised course when competing metals and materials, under the pressure of intensive promotion efforts, are steadily forging ahead in fields once almost entirely dominated by copper and its alloys.

Then how is the copper industry to be stabilized, to protect itself from these constantly recurring dangers of over-production? This question brings me squarely

up to the ultimate consumer, and by the ultimate consumer I mean everybody who uses pins, hardware, screws, nails; the man who owns a home or is about to build one and has the problems of roofing and plumbing to consider; the men who are engaged in the erection of office-buildings, apartment-houses, or hotels, and who in addition to their roofing and plumbing, have thousands of articles of ornamentation such as door-knobs, hinges, locks, bolts, window-catches, electrical apparatus and fixtures, and a myriad of other things to consider; the man who is going to buy an automobile and will never know unless he is told that vital parts formerly made of copper, because of its non-rusting qualities, are now made of steel.

I could make this list almost any length, for it is a fact that copper, brass, bronze, and other copper alloys, go into many hundreds of small articles that are in use in every American home. The enormous total tonnage represented by these things may be gauged from the fact that nearly 2,000,000 lb. of brass go into the manufacture of pins alone each year in this country.

Pins, by the way, are the only form in which copper goes into consumption, that represents no return in scrap. No human being has ever yet been able to find out what becomes of the pins.

To create a steady demand for copper and copper products, I believe it is necessary to work from the ultimate consumer up. You will rarely find a man who knows the qualities possessed by these metals using anything else, where resistance to corrosion, long life, and good service are required. When you have created an ultimate consumer demand, you have created a demand on the manufacturer of metal products, who soon hears of what the people want through the retailers with whom he comes in direct contact. The manufacturer is never slow to meet a demand, and his needs reflect themselves in increased orders for the products of the rolling-mills, to meet which the fabricator must buy more and more copper from the producer.

I will not dwell upon copper for electrical purposes. Copper for export depends on financial conditions and needs abroad, and cannot be controlled to any great extent by domestic promotion efforts. But the domestic consumption of copper—the output of which from our rolling-mills in finished materials in 1919 was 700,000,000 lb. without including wire—can be greatly increased and stabilized by public education.

While such a war as that just ended creates a tremendous demand for copper, it must be remembered that while it lasts it takes the metal entirely out of ordinary commerce. So when a war is over copper has got to work its way back into general use and it always finds a host of rivals that have flourished in its absence, ready to give it battle.

During the World War all the copper that could be produced was taken for munitions. When the War ended our Government had an enormous supply of the metal on hand, and the mines were still turning out at an extravagant cost of production, justified by the

emergency and by the protection afforded by the 26-cent rate fixed by the Government. So with the end of the War copper had to face a serious over-production, taken out of the mines at extravagant cost and no longer protected by the Government price. It also had the handicap of having been out of commerce for several years, during which time its rivals had securely entrenched themselves.

The job that copper had on its hands when the War ended was to get itself back into industry as quickly as possible. And here is where early neglects came home to roost. Those who had been compelled to sell substitutes during the war period made much larger profits out of these substitutes than they ever made out of copper or brass. Therefore they had no particular enthusiasm about promoting the interests of these metals.

Architects, builders, and plumbers, idle during the war period and hungry for work, refused to discourage prospective clients by specifying copper or brass for roofing, plumbing, or ornamentation, because to do so meant to increase the amount of a building budget.

Manufacturers of screws, screw parts, nails, and hardware generally, did very well with steel, thinly coated with copper or brass during the War; and as long as the customer made no complaint they did not think it necessary to return to real copper and brass afterward. And so it went all along the line, a situation tremendously aided by the advertising and educational work of the makers of these substitutes, who, sensing the menace in the return of copper and brass to commerce, redoubled their efforts to keep all that they had gained during the War. And in the main they have succeeded in keeping most of what they picked up while copper and brass were doing duty at the front.

When we started to find out what was the matter with copper and brass we made out a list of all consuming industries and all trades and professions that had either a direct or indirect influence on the consumption of these metals. Then we made first-hand studies of these industries, which included personal talks with the leading men in them. I would like to repeat to you some of the things these men told us. I will start with architects, and the architects are important because with their specifying powers they practically control the materials that go into building. Among architects there is almost complete unanimity concerning copper and brass. They do not regard any other metals used in the building as comparable to them, and they prefer to specify them as a matter of professional pride because they are the best, and naturally reflect credit on the architect when they are used. But architects were hard hit during the War, when building was at a standstill, and they needed all the work they could get. They told us that almost every client that came to them insisted on keeping his building budget within certain definite figures. There was no cutting the cost of standard building-materials, which was high right after the War, and there was no cutting the cost of labor. What they could do, and did do, was to eliminate from their specifications all materials having

a high initial cost and for which cheaper substitutes could be used. Of course, copper and brass came under this head, and they were ruthlessly sacrificed. Our architect friends told us they never had any trouble in doing this, as not one out of a hundred clients knew anything about copper or copper products.

Builders, plumbers, and roofers told us the same thing; many of them frankly admitting that they had gone so far as to argue clients out of the use of copper and brass, in order to keep a building budget down to a point where the client would be encouraged to proceed with his enterprise. In most cases, however, they said that the substitution of other metals for copper and brass went unquestioned.

Automobile manufacturers told us that they had cut copper and brass down to the lowest possible point during the War, because of the scarcity of these metals, and that they had continued the use of steel and certain patented alloys after copper and brass again became plentiful, because they found it cut down the cost of production and did not bring any complaint from the customers. At the same time they admitted that the tremendous growth of the automobile-repair business in this country during the past five years was due in no small way to the substitution of other metals for copper and brass in the working and structural parts of automobiles.

I have already mentioned the hardware industry, but there is one phase of this industry to which I want to call particular attention. Ninety per cent of these who today are buying copper- or brass-coated steel nails or screws believe that they are buying articles of solid copper and brass. When these articles fail to give satisfaction the fault is attributed to some shortcoming in the metal, and both copper and brass suffer in reputation.

I have already mentioned the losses of copper in the utensil field. Here is the situation on utensils as given to me by the leading dealers in kitchen-ware. Fifty per cent of all the kitchen utensils sold in the United States today are made of aluminum; 25% are of enamel-ware of different makes. The remaining 25% is divided among copper, iron, glass (Pyrex), and Monel metal, copper representing 6% of the whole.

Yet copper is admittedly the best metal for utensils, in spite of certain handicaps. Chief of these are the cleaning and the necessity of tinning. The cleaning problem should be overcome if any particular study ever had been made of it. But in present circumstances the tinning is an expensive operation and there are few places where it is done. In Europe the dealer in copper utensils takes care of these things. They have scores of different kinds of powders and pastes specially made for cleaning copper, and even in the smallest villages there are tanners who make a specialty of tinning the inside of the copper vessels used in cooking.

Among large manufacturers of foodstuffs, and in hotel and steamship kitchens, copper is still used to a considerable extent, but if you have watched the magazine advertising during the past year you will see that both the aluminum and Monel metal interests are making

a drive for this field and have developed special grades of metal to meet its requirements.

I need hardly tell you gentlemen of the superiority of brass over any other metal for piping, especially for hot-water supply. Yet in the large office buildings, hotels, and apartment houses in this city brass represents but a small percentage of the total outlay for plumbing. For instance, the plumbing in the Woolworth building cost \$450,000, of which only \$32,400 represents brass pipe. In the Western Union building the plumbing cost \$260,000, of which only \$19,500 went for brass pipe. The plumbing in the Commodore hotel cost \$900,000, of which \$3150 was spent for brass pipe. In the Pennsylvania hotel, the total cost of plumbing was \$1,450,000, of which \$36,000 represents brass pipe.

When I tell you that one of the largest manufacturers of brass piping in the country, a man who spends thousands of dollars annually inducing plumbers to encourage the use of his product, recently built a home for himself and installed iron piping, and that one of the largest fabricators of brass in the country has his entire plant equipped with glass door-knobs and glass hand-rails, you will understand how loosely the interests of the metal are cared for by the very men who produce it.

In the course of our studies we ran across many interesting things. We found that complaints were coming from all over the country that shingle roofs began leaking after being installed a comparatively short time. It did not require much investigation to explain this. The roofs had been laid with steel nails. As soon as the brass coating wore off, the nails began to rust, eating holes in the wood.

We learned that large manufacturers of women's garments and dressmakers generally were complaining that much material draped on forms had been ruined by the rusting of the pins used to hold it together. The explanation was simple. Steel pins, tinned, had been substituted for the brass pin, tinned, which was standard before the War. These are still being sold and will, I have no doubt, continue to be sold until a better understanding sends the dressmaker into a store with a demand for brass pins and a refusal to take anything else.

Merely to illustrate the losses that copper and copper products have suffered as a result of the War, I will mention two incidents. A large manufacturing concern in Ohio uses a 50-lb. metal box in which to encase a machine that it makes. Before the War this box always was made of brass. During the War, when brass was hard to obtain, steel was substituted. Steel is still being used. As the company turns out something like 400 of the machines a day, the annual loss to brass by this substitution is around 6,000,000 pounds.

The National Acme Manufacturing Co., of Cleveland, Ohio, manufactures screws and screw parts. Before the War it regularly cut 10,000,000 lb. of brass per year. During 1919 its consumption of brass was less than 3,000,000 pounds.

And so we find it through all the industries, galvanized iron, steel, zinc, and plastic materials substituted for

copper in roofing, iron substituted for brass in plumbing, and steel for both copper and brass in automobiles.

Once in a while these short-sighted economists come a cropper. About a year ago a large manufacturer of electric batteries in the Middle-West decided to substitute brass coated steel knurls for solid brass knurls on his batteries. He equipped 500,000 batteries in this way and figured he had worked a fine saving for himself, as every test he made indicated that the steel knurls gave perfect service. But in shipment the acid in the batteries came in contact with the knurls, utterly ruining them. He was obliged to call back shipments of these batteries from all over the country, remove the steel knurls, and put on brass ones before he could safely market them. This manufacturer told an associate of mine that the experiment had cost him thousands of dollars and would have seriously injured his business if the batteries had ever been put on the market. He will never use a substitute for brass again.

It is not my purpose in this paper to detract from the merits of the many metals and materials that have taken the place of copper and copper products; on the contrary, all of them have their uses. But there are fields in which copper is incomparable because of its resistance to corrosion, its easy handling of contraction and expansion, its uniformly excellent service, its everlasting life, and its salvage value.

In these fields, it seems to me, it should not be allowed to suffer, and I do not believe it would suffer if there was a better understanding of its real merits and the merits of the various alloys of which it is the principal content. A few months ago one of the largest roofers in this country told me that the cost of copper roofing, labor and material, was 45 cents per square foot, and the cost of galvanized iron, labor and material, 25 cents per square foot. Architects, builders, and roofers, he said, were inducing thousands of people to use the galvanized iron because it represented an initial saving of 20 cents per square foot. At the end of twenty years, however, this roofer estimated that with replacements and upkeep the galvanized iron would cost \$1.90 per square foot, with another entirely new roof about due, while the copper roof still would represent the 45c. investment, be perfectly good for another twenty to forty years of service and have a salvage value pretty close to what the material originally cost.

A large contracting plumber gave me a similar story about brass piping, and of some fifty prominent architects who were canvassed not one dissented from these estimates, or expressed any other view than that copper and brass were in a class by themselves for general building purposes and when used represented a very substantial economy in the long run.

Wherever copper or copper products are understood, they are used. In Germany whole store-fronts are of sheet-copper. In Turkey and certain other countries man's wealth is measured by the number of copper kettles he owns. In this country the virtues of copper and its alloys are not generally understood.

The Theory of Flotation

By Reginald S. Dean

INTRODUCTION. Flotation theory seems to be developing largely along the lines of study offered by the thermodynamical treatment of surface-tension phenomena. It cannot be denied that in the laws of thermo-dynamics we possess tools of the greatest importance and by this means many of the facts of flotation have reached a more or less lucid explanation. The recent paper of Sulman¹ has pointed out the conclusions that can be arrived at by thermo-dynamic means. In the present paper, however, I shall attempt if possible to get a definite physical conception of the various processes involved in flotation at the expense, perhaps, of the security one feels when treading the safer path of thermo-dynamics.

FORMATION OF A FROTH. Fortunately we have an exact physical conception of what happens when a frothing-agent is placed on a water surface, or, as the case may be, dissolved in water. For this conception we are indebted to Langmuir² and Harkins.³ For the purpose of illustration let us consider the action of oleic acid at an air-water interface. Oleic acid has the formula $C_{17}H_{33}COOH$, it belongs to the type of substances that Harkins refers to as polar, that is, one end of the molecule differs markedly in properties from the other end. Now

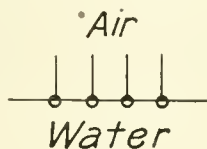


FIG. 1

when one of these oleic-acid molecules, in which *o* (see Fig. 1) is the polar group, in this case carboxyl, comes in contact with water the carboxyl group being soluble in water⁴ turns toward the water and the molecule is oriented as shown in Fig. 1. All the oleic-acid molecules will behave alike, so that if there is not too much oleic acid it will spread out to a layer one molecule thick. Similarly if the substance is soluble in water the surface layer will

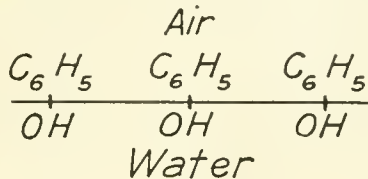


FIG. 2

have oriented molecules if they possess a polar group, or, in other words, polar substances are adsorbed at the air-water interface. Thus with phenol, C_6H_5OH , we have an orientation as in Fig. 2, the hydroxyl group being the soluble portion.

If a substance possesses no polar group, it will not spread at an air-water interface, thus paraffin oils do not spread. We are therefore in a position to infer with reasonable certainty from its chemical formula whether a substance will spread on water to a layer one molecule thick or not.

From this to the formation of froth is a simple step. If there is sufficient polar substance present it will spread on all the available air-water interface. By introducing bubbles the air-water interface is increased, so it is to be expected that the substance will spread at the surface of the bubbles; this gives a froth. A froth is an aggregation of bubbles with a polar substance spread over their surface. The function of the polar substance is, clearly, to stabilize the aggregation. The stability of the froth depends on the nature of the adsorbed substance. The separation of flotation agents into frothing and non-frothing is an artificial one. All substances that are effective in flotation when used alone must possess frothing properties, as will be clear later. The kind of froth produced by the two types of flotation agent is different, but all flotation agents must be capable of adsorption at bubble surfaces. The question of the action of a mixture of polar and non-polar substances could readily be determined experimentally and would answer the once interesting question as to whether, in a mixture of paraffin and pine-oil, the paraffin is a part of a functioning mixture.

INCLUSION OF THE ORE-MINERAL IN THE FROTH. It has been pointed out by C. T. Durrell⁵ that adsorption or solution of a gas by a mineral is a necessary condition to the flotation of the mineral. This has perhaps not been conclusively proven, but there are a number of facts which point to its correctness. The amount of various gases adsorbed by the sulphide minerals is especially large. The only quantitative data with which I am familiar on this subject were obtained by H. Bajoulian under my direction at the University of Pittsburgh some years ago. The following table gives the number of cubic centimetres of gas absorbed by 1 cc. of 80-mesh mineral.

Gas	Mineral			
	Galena	Sphalerite	Chalcocite	Copper
Air	0.018	....	....	....
H ₂ S	0.889	0.814	0.624	0.399
H ₂	0.234	0.036	0.108	....
CH ₄	....	0.122	....	....
SO ₂	....	1.139	1.082	4.254

⁵C. T. Durrell, 'M. & S. P.', CXI, 428.

¹H. L. Sulman, Inst. Min. & Met., November 1919.
²I. Langmuir, Jour. Amer. Chem. Soc., XXXIX, 1848 (1917); also Trans. Faraday Soc., XVI, 62 (1920).
³W. D. Harkins, Jour. Amer. Chem. Soc., XLI, 970 (1919).
⁴I assume the solubility of the carboxyl group. As the hydrocarbon chain is shortened the acids become more soluble, finally, as with acetic acid, CH_3COOH , and formic acid, $HCOOH$, there is complete miscibility.

We see that the amount of such unsaturated gases as hydrogen sulphide and sulphur di-oxide absorbed is particularly large, and even air is absorbed appreciably by galena. The amount of these gases absorbed by silica is practically nil, and calcite absorbs only the acid gases. Whether these gases are adsorbed or dissolved is of no importance just here. We do seem justified, however, in assuming that a sulphide mineral will have a gaseous envelope under normal circumstances. From the amount of absorption we would infer that the gas is held rather tightly, and this is true of metallic surfaces in general as compared with such substances as mica. Water will not therefore displace the gas. Any mineral that absorbs gas strongly is nothing more than a weighted bubble when placed in water; in the flotation process it becomes a part of the froth, the buoyancy of which is sufficiently great to lift the mineral.

EFFECT OF ADDITION AGENTS. This theory of flotation leads to a simple chemical explanation of the effect of many addition agents. The value of acid in zinc flotation is doubtless due to the evolution of hydrogen sulphide from the sphalerite to give a gaseous envelope. In a previous article^c I have explained the action of the Bradford process on this basis. The accelerating action of copper sulphate in floating some sphalerite is probably due to its increasing the ease of solution of the sulphide, just as copper sulphate increases the rate of solution of zinc in acid. In the latter case, copper is deposited; in the former, copper sulphide. In the extended work of Mann and Thornberry^d on the use of addition agents in the flotation of a lead ore in a limestone gangue they found that only cadmium, uranium, and stannous salts were particularly deleterious. This may be explained by the precipitation on the surface of the galena of the sulphides of these metals; this would certainly take place with cadmium and tin; uranium is doubtful. Many other addition agents were tried that will give precipitates with lead sulphide, but most of them, as with silver and mercury, would probably absorb gas or might be thrown out of solution by the limestone. A knowledge of the gases absorbed by actual minerals would certainly throw some light on the action of addition agents toward them.

Another type of addition agent is one that affects the polar character of the flotation agent. Thus sodium hydroxide, added to the pulp when coal-tar is being used, forms salts with the phenols and cresols present, which are more soluble and hence more polar than the phenols. A number of similar instances might be mentioned. Some addition agents might destroy the polarity of the flotation agent altogether; this is the case with the addition of acids to some amines. It is evident that the chemical properties of a flotation agent may be as important as the physical properties and they are much more easily predicted.

In the foregoing only the simplest cases have been treated, and important relations between the nature of

the mineral and gas adsorbed have not been discussed, but I believe the theory as outlined constitutes a usable working hypothesis. In conclusion, I may summarize the conditions necessary for flotation according to this theory:

1. A gaseous envelope around the mineral to be floated.
2. A polar substance as a flotation agent.
3. The absence of addition agents that will react chemically with the gaseous envelope or the surface of the mineral or affect the polarity of the flotation agent adversely.

Mint for China

The first step in an effort toward uniformity in Chinese currency will be undertaken by the building in Shanghai of China's first national mint. The work will be directed by an American expert, Clifford Hewitt, of Philadelphia, whose services have been loaned to China by the United States. Mr. Hewitt installed the new mint at Manila, the first established in the Philippines. It is expected the completion of the Chinese mint will put an end to the conglomerate system of currency of all kinds and values which has long been a drag on the commercial progress of China. Although the Mexican dollar, introduced into China from the Philippines, has come to be the common unit of value, the various tuchuns, governors, and other officials of provinces have issued coins that are dealt with commercially at values based on the quantity of their silver content. The Chinese tael in which government funds and customs ordinarily are reckoned is not a coin at all, but a silver slug of a given weight and fineness, differing in weight and value in the different provinces. The Shanghai mint is to cost about \$2,000,000 and will be one of the largest in the world, rivaling in size and output the mint at Philadelphia. It is to have a capacity of 500,000 silver dollars per day with a daily consumption of 14 tons of silver in addition to baser metals used as alloys. Mr. Hewitt hopes to have the plant in operation within two years. He is the originator of many of the machines and processes in use in American mints, having been in the service of the United States government 24 years. He built the American mints at Denver and Philadelphia.

THE COLOMBIAN CONGRESS on November 20, 1920, passed a law permitting the free exportation of gold in all its forms except money, upon proof that such gold is not the result of the melting down of gold coins, states a consular report. It is apparently the general belief here that this permission, together with the decrease in imports incident to the high rate of exchange, will, for a time at least, effect a gradual lowering of this rate. The active exportation of gold, which has been carried on for some months past by speculators on the coast, has been closely correlated with the fact that the rate of exchange has averaged considerably lower on the coast than in the interior. This, of course, has had the effect of drawing gold from the interior for the purchase of drafts on the United States.

^cR. S. Dean, *Chem. & Met. Eng.*, XXIX, 372 (1919).

^dH. T. Mann and M. H. Thornberry, *Bull. Mo. School of Mines*, Vol. V, No. 2.

The Sampling and Estimation of Quicksilver Ore

By C. N. Schuette

Much has been written on the theory and practice of mine-sampling,* but with one exception† I have failed to notice any discussion of the sampling of quicksilver ore. The following remarks on factors affecting the sampling of such an ore may be of interest.

Quicksilver ore occurs in a variety of gangue materials the most common being sandstone, limestone, serpentine, andesite, rhyolite, basalt, and chert. Two general types of deposits are found. These are low-grade (two to five

Fig. 2 is a section of the Oceanic mine, in San Luis Obispo county, California. Here the 'mud-rock', a gray fine-grained sandstone, formed the impervious stratum and the mineralizing solutions deposited the cinnabar in the underlying coarser sandstone. This particular impervious bed was only relatively impervious; and the 'mud-rock' constitutes a low-grade orebody, so that in this mine neither wall is well defined.

Fig. 3 shows a section through the Cloverdale mine in Sonoma county, California, in which the cinnabar is deposited in extensively fractured flat strata of radiolarian chert. This chert is capped by an impervious gouge and the ore becomes poorer from this gouge outward.

Fig. 4 gives a section through the

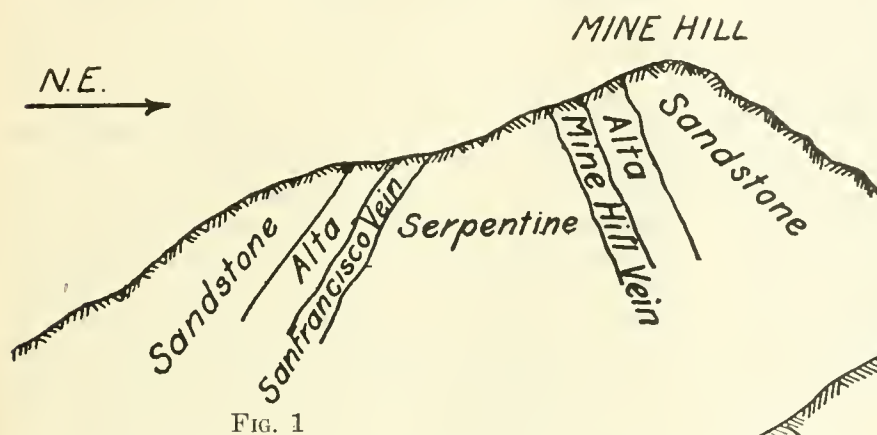


FIG. 1

pounds of mercury per ton) evenly disseminated ores, and ores of irregular deposition.

A clear conception of the geology is of the utmost importance in the examination of a quicksilver deposit. In the formation of most deposits of this ore, two factors appear to have been dominant: first a relatively impervious stratum directing or limiting the upward flow of the mineralizing solutions, and, second, the porosity of the rock underlying this impervious cap. The generalized cross-sections of several mines, shown in Fig. 1, 2, 3, and 4, illustrate the influence of these two factors.

Fig. 1 is a section of Mine Hill at New Almaden, in Santa Clara county, California, after Forstner.‡ The 'alta' here forms the impervious stratum and the distribution of the ore depended on the inclination of the 'alta' and upon the intensity of fracturing in the vein-material.*

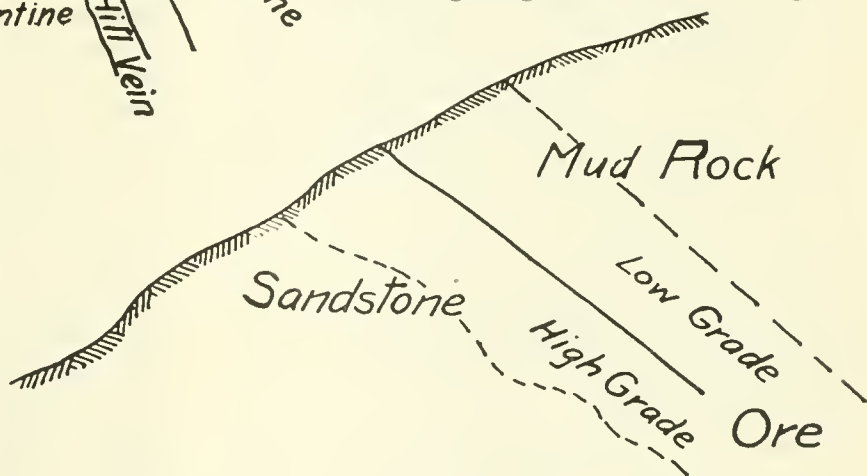


FIG. 2

Mariscal mine in Brewster county, Texas. Here the mineralizing solutions ascended in a fissure in the limestone and were arrested in their upward course by a sheet of intrusive rock.

Mr. Forstner's bulletin, cited above, gives numerous sections showing similar relationships.

At the St. John's mine, in Solano county, California, the ore occurs in dike-rocks brecciated by faulting.§ The soft shale surrounding the dike-rocks formed gouges, but did not brecciate on faulting; hence no open spaces were formed in the shale for the circulation of the mineralizing solutions.

In several mines the richest ore is found filling the interstitial spaces in coarse breccia, as at the Chisos mine in Texas and at the Goldbanks mine in Nevada.

Associated minerals are significant. Thus pyrite may be an indication of the nearness of cinnabar. In a few mines a pyrite stringer may lead to cinnabar within a

§Bulletin 78, California State Mining Bureau, 'Quicksilver Resources of California', by W. W. Bradley.

*'The Sampling and Estimation of Ore in a Mine', by T. A. Rickard.

†'Difficult Mine Sampling', by E. B. Crane, 'M. & S. P.', April 21, 1917.

‡Bulletin 27, California State Mining Bureau, 'Quicksilver Resources of California', by William Forstner.

*The Spanish term 'alta' refers to a dark gouge or clay on the hanging wall of quicksilver lodes in California, particularly at New Almaden. The word 'caliche' is used for the same purpose at the New Idria mines.—Editor.

distance of about 30 ft. In one mine were found two types of calcite vein filling; one formed thin coatings of fine crystals and was associated with the ore, while the other formed large crystals and masses nearly filling the barren veins.

The cost of development work in quicksilver mining is high on account of the irregularity of the orebodies. Development work if possible is done in ore. The cost of driving raises and drifts is higher than the cost of stoping, so that the tendency is to run drifts and connections in the best ore rather than at regular intervals.

The hanging-wall limit of the ore is generally sharply defined, whereas the foot-wall side is less definite. The assay-value of the ore may change rapidly and without warning, so that a good deal of waste is unavoidably broken on the foot-wall side of the deposit, this barren rock being sorted out at surface. The breaking of this waste makes the stoping-width appear larger than it actually is. Cinnabar ore, because of its bright red color, is easily sorted, as much as half the ore mined being picked out as waste at some mines.

Operators have been criticized for lack of sampling and assaying at their mines. When the outbreak of the War stimulated the industry to unwonted activity, several engineers having no previous experience with quicksilver began at once to 'modernize' the industry. One step in this process was extensive sampling and assaying, with ludicrous results, as this ore cannot be sampled in the manner usual with other ores. Cinnabar is so very brittle that groove-samples are untrustworthy except in low-grade and evenly disseminated deposits. This very brittleness of cinnabar, however, makes it amenable to accurate estimation by panning. Thorough rubbing of the ore between the hands liberates the cinnabar from the gangue, and the larger pieces of gangue, after inspection, can be discarded.

This method of estimating the content of an ore is rapid and with practice a surprising degree of accuracy is attained. Certainly the accuracy of estimation is well within the sampling-error. This statement may seem an exaggeration to many, but panning, when done by experienced men, is recognized as a legitimate method of estimating ore in the quicksilver industry the world over. Oschatz states¹ that most of the miners at Monte Amiata, in Italy, are proficient in panning. He cites one who could invariably check assays within a limit of error of 0.1% mercury. That is exceptionally good work on the high-grade ore of those mines, but on low-grade ore and with careful panning even closer results are obtained. The error of a number of samples is compensating rather than cumulative.

The development work of quicksilver mines is not generally carried far enough ahead of mining operations. For this reason and because of the irregularity of the orebodies, both in shape and value, it is necessary to sample the various working-faces after each blast, in order that the requisite tonnage of a certain average grade can be

delivered to the reduction plant. This sampling is done by inspection or by panning. The former is a fair method of judging ore, as cinnabar is readily visible on a clean face. For the latter method, an old carbide-can or pail full of water and a small six inch pan are kept near each face.

With practice the foreman and miners become expert in predicting the change to be expected by the next blast, so that dressing a quicksilver mine for examination can be carried to the point of fine art.

All quicksilver mines have their own reduction plants, so that the engineer, knowing the amount of waste sorted, can check his daily pannings against actual production, and thereby becomes proficient in estimating the quality of the ore.

To sample a quicksilver mine, the examining engineer should be familiar with quicksilver ore and the mining of it. The first requisite for an examination is a map of the mine. With this map and a prospector's pick, a visual examination should first be made to determine the geologic relationships of the orebodies and the general trend and limits of the mineralized zone. Following this preliminary examination the mine should be blocked into the smallest units permitted by the mine-openings. A visual determination of the grade of ore in each block should then be made, the value being estimated at fixed intervals along the cleaned faces, and plotted on the map. This visual examination is followed by panning samples at fixed intervals along the faces, the samples to be cut with a prospector's pick in the same manner that the daily samples are usually taken. The results of these two estimates should then be compared and any unreasonable discrepancies should be adjusted after re-estimating the section in question.

In the calculation of tonnage, particular attention must be paid to the density of the ore, as this may vary as much as 20% in the same mine. This difference in unit-weight is found between high and low grade ore, owing to the difference in cinnabar content, or it may be due to a difference in the pyrite content of the ore, outcrop ores generally being devoid of pyrite.

In determining the future possibilities of the mine, it is important to have a clear conception of the general trend of the mineralized zone. Generally speaking, all the separate orebodies can be encompassed in an imaginary lens, as suggested in Fig. 5, the lower axial extension of which points in the direction of possible orebodies. This has less bearing on the possible existence of other orebodies than the geologic data, but it aids in determining the probable cost of mining such possible orebodies.

The sampling method outlined above is possible because cinnabar is readily visible to the eye on clean faces, and, owing to its brittleness, is amenable to accurate estimation by panning. This method of sampling a quicksilver mine, when carried out by an experienced engineer, will give the content of the orebodies as accurately as the content of more regular orebodies of other metals can be determined by standard sampling practice.

¹K. Oschatz, 'Die Verhüttung der Zinnobereze am Monte Amiata, in 'Glückauf,' September 28, 1918, p. 609.

The price of quicksilver is so unstable, in addition to the irregularity of the orebodies, that a quicksilver mine, to be attractive to capital as a venture, must promise a larger margin of expected profit than other mines. This gives a larger factor of safety for the actual capital invested in a quicksilver mine, provided only that the

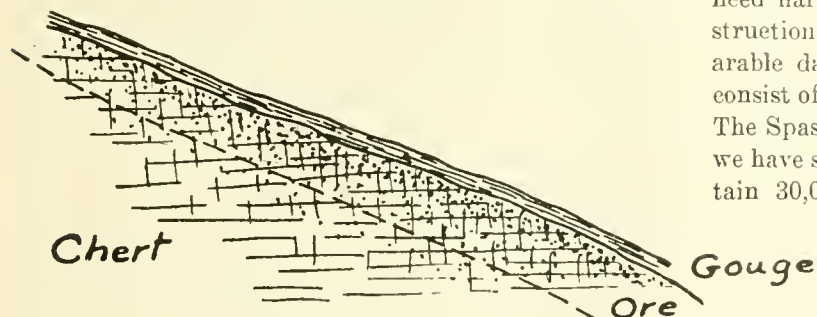


FIG. 3

investment was based on the report of a competent engineer.

Spassky Copper Mine

At a recent meeting of the Spassky Copper directors the chairman said:

"We have again been cut off from our properties for twelve months, but I am glad to be able to give you some news of as late a date as August last. A gentleman who has recently returned from Western Siberia has been good enough to give us some highly interesting information. It appears that no

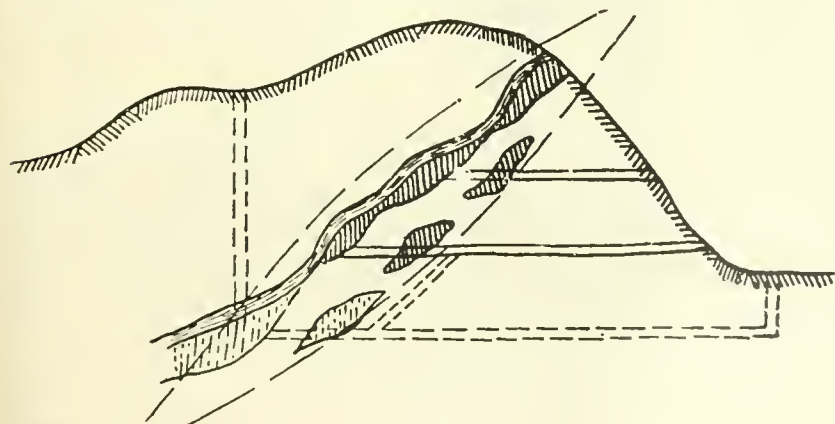


FIG. 5

damage has been done to the Spassky properties, and that the colliery at Karagandy is being worked on a small scale to supply local demands for coal. The smelter was not then being run, although it was reported that they intended to start it to work on some concentrates. The Yuspenssky mine is unwatered, and the pumps are being kept going. At Atbasar no work was being done, but a young Russian engineer was in charge as caretaker. Food supplies are said to be very short, and clothing practically unobtainable. The transport question is more difficult than ever owing to the shortage of horses, oats, repairs to carts, etc., and in con-

sequence there is a serious timber shortage. Beyond small thefts of movables by looting marauders you will hear with satisfaction that no serious damage has been done at any of our properties. Having regard to the actual position in Russia this is, I think, about the most satisfactory news that we could have received, because I need hardly point out that anything like organized destruction might have resulted in serious and almost irreparable damage. Our properties, as most of you know, consist of two main groups, the Spassky and the Atbasar. The Spassky group includes the Yuspenssky mine, where we have some 400,000 tons of proved ore estimated to contain 30,000 tons of copper, and the Karagandy coal

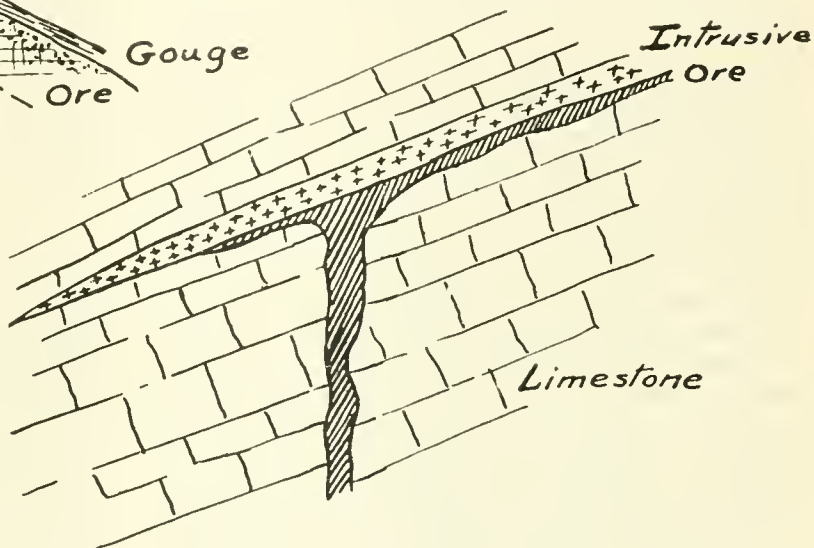


FIG. 4

mines, estimated to contain 400 million tons of good coal. There are also large smelters and works at Spassky, with our own railway connecting it with Karagandy, and then there is a concentrating plant at Sari Su.

"In the Atbasar groups we have huge copper deposits, of which we have only worked over a very small portion, but we have already proved upward of a million tons of ore, estimated to contain approximately 100,000 tons of metallic copper. In this group, also, we have coal deposits at Bai Kanour, although of an inferior quality to those at Karagandy, and a large smelter

which is partly completed. It would have been finished long ere this had it not been for the War and the subsequent revolution, and you would have been receiving substantial results for the money you have invested in that part of our undertaking. This very brief summary will show you that the possibilities of damage were large, but as we have avoided it so far it is not unreasonable to hope that we shall continue to do so, and particularly because we have a good record throughout the Steppes, and have done a great deal to raise wages and the whole standard of living among both Russians and Khirgees."

Income-Tax Returns

For the calendar year 1918, 4,425,114 individuals filed returns in the United States reporting aggregate net income of \$16,000,000,000, income tax on which was \$1,127,721,845. These figures register a growth above 1917 of nearly 1,000,000 returns and approximately \$2,273,000,000 net income, as well as an increase of approximately \$137,000,000 in tax paid.

Of personal returns filed, 1% representing 43,000 people with incomes in excess of \$25,000 reported 17% of total personal net income and paid 66% of personal tax, whereas 99% of returns representing incomes under \$25,000 reported 83% of net income and paid 34% of the tax.

Of this great aggregate income, salaries and wages produced nearly half, or \$8,300,000,000 and business is credited with slightly over 25% or \$1,600,000,000. These two sources, representing incomes from personal endeavor, contributed nearly three-fourths of income reported. Of 958,000 people who reported incomes from business pursuits, 39% were engaged in agriculture, and reported net income of \$1,123,000,000.

Comparing 1918 with 1917, there was a slight decrease in returns filed by individuals having incomes between \$1000 and \$2000; there was a very large increase in those reporting incomes up to \$25,000, from which point on through the higher income classes a steady decrease is recorded. In 1918, 6457 fewer persons reported incomes in excess of \$25,000 than in 1917. The class reporting incomes of \$1,000,000 and over lost 74, the number between \$500,000 and \$1,000,000 decreased 137, between \$300,000 and \$500,000 the decrease was 177, between \$150,000 and \$300,000 it was 833, and between \$100,000 and \$150,000 it was 944.

Correlating the decrease in number reporting in higher income classes, between 1918 and 1917, with sources of income reported, those with net of \$100,000 and over show a decrease of 2165, and aggregate decrease in income of \$521,000,000, of which approximately 79% was due to decline in dividends; interest on investments decreased \$65,000,000 or 12%, and rents and royalties \$11,000,000 or 2%. Salaries, fees, and commissions showed a net reduction of \$40,000,000, whereas business, partnerships, and profits from incidental sales of securities and real estate increased \$4,000,000.

In income classes from \$20,000 upward, the falling off in dividends was \$559,000,000, whereas in classes between \$2000 and \$20,000 there was an increase from this source of \$133,000,000. Whereas interest on investments reported by persons having incomes in excess of \$20,000 fell off \$80,000,000, such income in class between \$2000 and \$20,000 increased \$406,000,000.

It would appear that the decline in dividends was more or less general and that although the lower classes up to \$20,000 showed an increase from this source, this was probably due to augmentation of 1,083,000 persons not previously reporting in these classes. However, it probably was to a certain extent due to acquisition of divi-

dend-paying securities formerly held by persons in higher income classes.

Corporations that filed returns in 1918 were approximately 318,000, exclusive of personal-service corporations, of which there were 3500. Of the above corporations 202,000 returned net incomes aggregating \$8,400,000,000, on which income tax was \$653,000,000 and war profits and excess profits tax \$2,506,000,000, making a total of \$3,159,000,000 or 38% of their net income. Number of corporation returns for 1918 was less than in 1917 by 33,000; and although net income reported was also below the amount returned in 1917 by \$2,370,000,000, the tax exceeded 1917 by \$1,017,000,000.

The decrease in net income was due in part to exemption of dividends from tax. Predominant in industrial groups of corporate industries, based on net income returned, was manufacture of metals and metal products, whose net income was over \$2,000,000,000 and represented 25% of aggregate income for all corporations.

Following this in order of importance are:

	% net of all corporations	Net income
Trade	13	\$1,055,000,000
Transport and other public utilities.....	9	778,000,000
Manufacturers of textiles and textile products	9	765,000,000
Finance, banking, and insurance.....	8	685,000,000
Mining and quarrying	6	568,000,000
Manufacture of food products, liquors, and tobacco	6	530,000,000
Manufacture of chemical and allied substance	5	395,000,000

Agriculture and related industries represent less than 1% of total net income reported by corporations.

Number of returns reporting lesser incomes follows:

Income class	Number of returns
\$500,000-\$1,000,000	1,171
250,000- 500,000	2,054
100,000- 250,000	5,383
50,000- 100,000	7,224
10,000- 50,000	37,053
5,000- 10,000	29,780
2,000- 5,000	49,397
Less than 2,000	68,973

The curious results of the operation of the profits tax, as evidenced by wide range in rate of tax paid by various industries, are of interest. The highest rate was paid by corporations whose business was classed as construction. Average rate of tax for this group was 54.10%, although within the group were several concerns whose tax averaged 67.76% of net income. The next highest was manufacture of textile and textile products, with average rate of 51.50%.

In the transportation and other public utilities group the rate of tax was 19.30%, and the finance, banking, and insurance group had the lowest tax rate of only 17.93%.

ROLLED GOLD, produced by the mechanical plating of base metals with a thin film of gold, was invented in Birmingham about 60 years ago, states a consular report. For a long time the exploiting of the invention was left largely to Americans and Germans. The fineness and thickness of the gold plating vary considerably. For links and chains the thickness of gold ranges from one-tenth to one-fortieth of an inch; for the cheapest kinds of imitation jewelry it runs as low as one-hundredth. For the majority of what are considered good rolled-gold articles, gold of 12- to 14-carat fineness is used.

The Licensing of Engineers

A bill has been introduced in the Montana Legislature that proposes to create a State Board of Engineering Examiners, for the purpose of licensing engineers. A committee of the Montana section of the A. I. M. & M. E. has prepared a report on the bill, which is given herewith.

SUMMARY OF THE LAW BY THE COMMITTEE. The bill affects all engineers and land-surveyors, including employees of other engineers and surveyors, and of corporations and individuals.

After one year from the passage of the Act, no person may engage in "professional engineering" without obtaining a certificate of registration (hereinafter called a 'license'). Professional engineering, as defined, corresponds generally to what is usually known as engineering work, except that it includes "the design and supervision of mining operations and of processes and apparatus for carrying out such operations". The execution of work as a contractor or as a subordinate under a professional engineer, or by an owner on his own property, is not deemed professional engineering.

License may be obtained, after examination, from a board of five engineers, to be appointed by the Governor. The board meets twice a year.

The character and scope of the examination is within the discretion of the board. The principal qualifications for examination are six years' practice of professional engineering or land surveying, or graduation from a recognized engineering school; and citizenship or 'first papers'.

The fee for examination is \$15. An additional \$10 must be paid for license, and license must be renewed annually, at a cost of \$5.

License to practice is not general, but extends only to specified branch or branches. A civil engineer may not practice as a mining engineer; a land-surveyor may not practice engineering unless specifically authorized.

Within one year of the passage of the Act, licenses may be issued without examination to engineers and surveyors who have practised ten years; graduation from an engineering school shall count as four years' practice.

Licenses may be issued to engineers from other States that have license laws similar to those of Montana, on payment of a fee of \$10. There is no provision for engineers from Canada or from foreign countries.

Violation of the law is punishable as a misdemeanor, with a maximum fine of \$500, or three months' imprisonment, or both. Government engineers and licensed architects are exempted from the provisions of the law.

AFFIRMATIVE ARGUMENTS. The bill was drawn up presumably by the Montana Assembly of the American Association of Engineers, at least they are now actively urging its consideration. In order that the merits of the bill could be fairly presented to those most interested, a

committee of the A. A. E. favoring the bill was asked to prepare arguments in its favor, and herein below is given the affirmative argument as set forth in the reply received from that committee.

"The constitutionality of such a law is based on its promoting public welfare by safeguarding life, health, and property. It will accomplish this by the elimination from practice of incompetent and ignorant men who pose as engineers, but who are not fitted by their training and experience to have responsible charge of engineering work. The State already regulates and accomplishes like purposes in the practice of medicine, dentistry, law, pharmacy, and architecture. The argument that the Engineers' License Law will not eliminate all incompetents is not a good argument against such a law, any more than it would be a good argument against licensing the medical or legal profession.

"The law will give engineers a legal standing. It will definitely decide just who are and who are not engineers. At the same time it will not prevent any bona fide engineer from either outside or inside the State from practicing.

"The law will elevate the standard of engineering practice due to the elimination of incompetent and unscrupulous men. It will tend not only to eliminate the class of men who make blunders, but also those who are dishonest in the practice of their profession.

"The operation of the law will be self-sustaining, as provision is made that at no time shall the amount of warrants exceed the total amount of fees paid under the Act.

"If it were possible to tabulate figures showing the annual expense to taxpayers caused directly or indirectly by incompetent engineers the total would be a very large one, and when it is also considered that engineering blunders often cause loss of life it is time to give serious thought to a measure which will tend to eliminate the men most likely to perpetrate these blunders. Under our present system of no regulation, a man who is a carpenter today may pose as an engineer tomorrow, and may actually attempt engineering design or execution of work."

NEGATIVE ARGUMENT BY THE COMMITTEE. I. The bill is not well drawn.

(a) Construed literally, it requires that the superintendent of every little mine and prospect be an engineer. While, in the exercise of common sense, the courts would probably hold that the law was intended to apply to the enumerated occupations only where professional knowledge was required, yet a decision to that effect would open all occupations to judicial inquiry as to whether they involved professional skill; and it cannot now be said who would and who would not come under the provisions of the proposed law.

(b) Section 1 provides that no person other than a registered professional engineer shall practise professional engineering in Montana. But Section 8 (c) says the applicant before admission to examination for registration, must show that he has been engaged in the practice of professional engineering for at least six years. A violation of Section 1 is required by Section 8 (c), for applicants other than engineering school graduates. He cannot get this six years' experience as a subordinate or assistant because Section 3 (c) 2, says "The execution as a subordinate, of engineering work, under the direction of a professional engineer", is not deemed to be the practice of professional engineering. Under the law as proposed it will be impossible for any, except engineering school graduates, and those already qualified by experience, to acquire the necessary practical experience in Montana to qualify for examination.

(c) There is no provision for the expenses of the board for the first year, during which licenses are not required to be taken out, and during which it is to be presumed no fees will be paid in. Furthermore, we doubt if qualified prominent engineers can be found to serve on the board thereafter at \$10 per day.

II. The arguments of the proponents of the measure, presented in various forms, amount to this, and to this only, that it will eliminate incompetent and unscrupulous men.

(a) No reasons for such a conclusion are presented. The experience in other States having similar laws is not given; and we may say that from our investigations as to the operation of such laws, we are unable to prophesy any good results in Montana.

(b) We do not believe the law will eliminate the unscrupulous or the incompetent engineer because:

(1) The board of examiners will not inquire into the honesty or integrity of the applicant for license. This being true, the law will not only fail "to eliminate unscrupulous engineers" but it will put Montana's stamp of approval on any engineer smart enough to pass the examination, and it will give him a standing which he otherwise could not obtain.

(2) Lack of employment does now and will continue in the future to curb sufficiently the activities of the incompetent engineer. The proposed law presupposes inability on the part of the employer to correctly judge the competency of his employee.

(c) No one would object to legislation prohibiting the misuse of the word 'engineer'; but the facts are that the real damage is not caused by men whose activities would be ended by the proposed law. Neither mining companies, railroads, nor municipalities employ for technical work men who cannot pass State examinations; and private citizens do not casually employ engineers as they do doctors and dentists. The real injury to the public and to the engineering profession comes from men who are competent enough, so far as examinations would show. Their sins are not mistakes, but misrepresentations.

(d) It is true that the board is given power to revoke licenses for fraud or deceit; but this power is necessarily

subject to review by the courts, before whom, on appeal, the fraud or deceit must be legally proven, and is legally unprovable. On the other hand, it is safe to say that the "legal standing" to be given engineers would be effectively cited in all engineering reports which were intended to mislead the public.

III. The bill purports to be for the benefit of the public; and its proponents have convinced themselves that such is its purpose; but if this law is for the benefit of the public, by what right is its cost imposed on the engineers? How will it benefit the public to exclude eminent foreign engineers from Montana? We submit that the underlying purpose of the bill is the protection from competition of Montana engineers.

Whether or not engineers ought to have such protection, we need not now consider; but we think that for such purpose the proposed law would be ineffective, and to the engineers not worth its cost to them; but more especially we think that an attempt to secure protection through a law camouflaged as a law for the public good, would not be in keeping with the high ideals of the engineering profession.

IV. To sum up: the law is not needed; the public has not asked for it; it adds another board to the list of State boards, already too long; it creates a few more political jobs; it imposes a serious burden, in time and money, on the engineers.

Respectfully,

SAMUEL BARKER JR.,
J. L. BRUCE,
F. W. BACORN,
RENO H. SALES,
E. A. BARNARD,
Committee.

In future years mining activities will probably form one of the principal sources of revenue of the territory comprising the Canton district of China, and the subject, according to a consular report, deserves emphasis because of the potentiality indicated through available information. Mineral resources of the region are of wide variety and richness, including coal, tin, antimony, copper, iron, limestone, wolframite, lead, molybdenum, zinc, quicksilver, gold, and silver. Causes which until now have tended to obstruct any large-scale development of these resources may be summed up as general backwardness of the people, unsatisfactory internal conditions, and lack of adequate transportation facilities in places. Furthermore, the wide fluctuation in value of silver, as compared with gold, at times automatically opens and shuts the door to foreign markets, discouraging attempts at steady production, and damaging organizations of trained workers built up by years of effort.

MUNTZ METAL is an alloy of 60% copper with 40% zinc, and is used in place of copper for amalgamating purposes. Its adoption has been said to result in certain advantages including less corrosion with cyanide solution than when the ordinary copper plate was used.



FROM OUR OWN CORRESPONDENTS IN THE FIELD

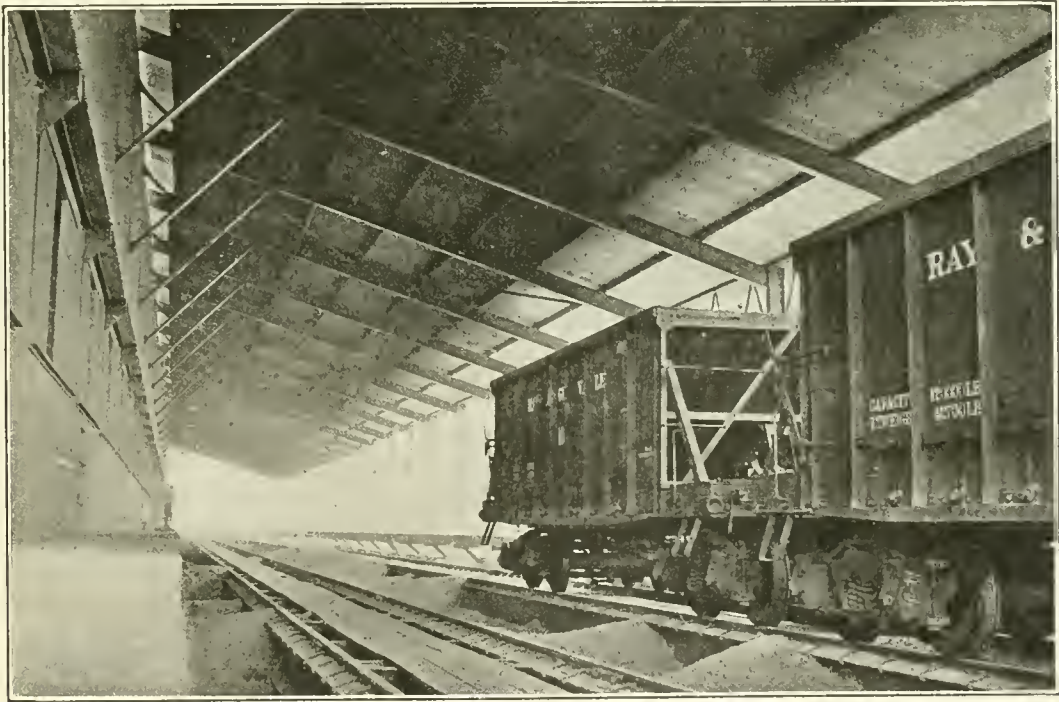
ARIZONA

SODIUM-SULPHATE PLANT WILL BE BUILT AT JEROME.

JEROME.—Plans for the erection of a 150-ton plant for the production of sodium sulphate, at an immense deposit near Camp Verde, have been announced by the Western Chemicals, Inc., of New York City and Tonopah, Nevada. Residents of the Verde valley first heard of the salt deposits at Camp Verde when a government expert warned them not to feed that particular kind of

	%
Sulphate of soda (Na_2SO_4)	99.76
Calcium oxide (CaO)	0.12
Magnesium oxide (MgO)	0.02
Chlorine (Cl)	0.10

The average price of 95% salt-cake, f.o.b. Clarkdale, is \$21 per ton, and the cost of laying down the finished material at that point has been estimated by Lindsay Duncan, San Francisco engineer for the Western Chemicals Co., at \$10 per ton.



TOP OF 25,000-TON ORE-BIN. RAY CON. MILL AT HAYDEN, ARIZONA

‘rock salt’ to their cattle. It now appears that the deposit is one of the most valuable of its kind that has ever been discovered.

The plant to be erected will produce 150 tons per day of neutral acid-free salt-cake, containing more than 99% sodium sulphate. The mining will be done by steam-shoveling and quarrying. Trams will convey the material to the crushing plant, and from there it will be conveyed to another part of the plant for the extraction of the insoluble material. The finished product will be ready for the market.

A government analysis of the sulphate follows:

TUCSON.—A strike of ore on the 300-ft. level of the El Tiro mine has been developed to show a total of about 7,600,000 tons in the ore-reserves, according to W. H. Buehlman, secretary and assistant manager for the El Tiro Leasing Co., which is now operating the mine. The development on the 300-ft. level came after driving for 1000 ft. through a barren zone. The ore has been cut for a distance of 40 ft. and opened by cross-cuts to 15 ft. in width, assaying 7.18% copper.

OATMAN.—A referendum among the miners to determine whether to go on strike or accept a cut in wages resulted in a vote favoring acceptance of a reduction of

pay under protest. Joseph Lord, Federal Mediator, conferred with the workers and operators. Two propositions were submitted. The first was: "Shall we accept the \$1 reduction proposed with a protest?" The second: "Shall we resist the proposed reduction by a strike?" There were 140 votes for the first proposition and 49 for the second. Ninety-five of the miners declined to vote.

COLORADO

CRIPPLE CREEK DISTRICT IS NOW ACTIVE.

BRECKENRIDGE.—Boyce Brothers, who last fall opened a quartz vein assaying from 2000 to 3000 oz. silver per ton, have a sacked shipment ready to be forwarded to the Leadville smelter as soon as the road is open for hauling by team.

Brooks-Snider lessees continue producing high-grade ore. A 14-ton shipment was sent to the A. V. smelter at Leadville last week from the Carl Williams lease, estimated to assay 100 oz. silver per ton. High-grade gold ore is being sacked on the Auge lease on the Brooks-Snider. Samples are classed as 'picture' rock and assay thousands of dollars per ton. The mills of the Wellington mines are still inactive, but underground development continues. Operations are to be continued on the properties of the Rilla Gold Mining Co., and the claims carried to patent.

CRIPPLE CREEK.—The Edna Forest M. & M. Co. is operating four machines in the cross-cut into Dante ground from the 12th level of the Gold Sovereign mine, and in developing veins exposed in the Dante shaft fourth and sixth levels. Offices have been established at Cripple Creek with Thomas W. Meers, secretary-treasurer, in charge. Many applications for leases are reported and many properties long idle are again active. The number of coaches on the work-train have been increased and are crowded with miners.

DENVER.—The State Industrial Commission has granted the request made by mining companies for a general reduction of 50c. daily without protest from miners in any of the camps affected. The men tacitly agreed to the reduction and mines are working full handed.

GEORGETOWN.—Operations are to be resumed on the Centennial and Tobin properties of the Palisade Copper Co. at East Argentine and preparatory work is now under way. The Centennial Level is to be extended to connect with the Tobin workings and an ore-zone in the Smith tunnel will be exploited. Rich silver-lead ore has been opened up on the Sunburst by George Teagarden and associates, assaying as high as 129 oz. silver and 25% lead.

IDAHO SPRINGS.—The Gem Mining Co. plans to remodel the Argo mill at an estimated cost of \$150,000. The original cost was \$200,000. An additional \$75,000 will be expended in mine development. The mill capacity will be increased to 200 tons per day. Milling and smelting-grade ores are being mined from the Argo tunnel on the Lost Mada vein, between the 1400 and 1600-ft. levels, the ore having high gold-silver-lead content.

MICHIGAN

ISLE ROYALE HOPES TO INCREASE YIELD PER TON.

CALUMET.—Slightly smaller 'rock' shipments by the Calumet & Hecla mines in January brought about a corresponding decrease in refined copper production for the month. The output of Calumet & Hecla proper, 4,671,200 lb., compared with 4,754,000 for December; Ahmeek's production of 1,818,300, compared with 1,914,500; and 744,800 for Isle Royale with 845,800.

Calumet & Hecla continues to do all of its stamping in its Calumet mill, the Hecla mill remaining idle. Eleven heads are in commission. There is no immediate prospect of an increase in production. Unless there is a sharp rise in the metal market Calumet & Hecla mine output will be kept within the capacity of the one mill. No amygdaloid 'rock' is being stamped, the entire output coming from the conglomerate shafts.

The Stanton mines now have a complete underground force. Mohawk production has come up from 2400 to 2600 tons daily and Wolverine is shipping close to 1000 tons. Both mines are just about at the peak in production. All four heads in the Mohawk mill are being used on Mohawk rock, while two heads are in commission in the Wolverine mill. Not all of the Mohawk-Wolverine metal is being disposed of, much going into storage.

If Wolverine does nothing more than remove its shaft pillars it will require eight years or more to complete that work. Pillars are now being taken out on the 38th level. Operations on this level will not be completed until April 1. The work then will be started on the 37th. It is estimated that about three months is required to finish one level, and there are thirty-seven still to receive attention. In addition to removal of pillars, miners are engaged in cutting out arches, backs of stopes, and widening out drifts. The pillars are yielding good ore, running from 15 to 17 lb. per ton.

In connection with Isle Royale's plan to increase its yield of refined copper per ton of rock stamped, to enable it to reduce costs and better meet depressed metal market conditions, it is interesting to note what has been done heretofore in the way of close rock selection. In 1916 about 19% of the rock hoisted was discarded. The copper yield that year was 13½ lb. per ton. In 1917 the percentage of discard was raised to 23% and the yield increased to 14½ lb. In 1918 the discard was 18%. The average run of rock was much better in 1918 than in preceding years and required less selection. The yield was 16 lb. per ton. The improvement in ground continued in 1919 and with a 19% discard the yield was 18 lb. per ton. It is hoped now to bring the yield up to 20 lb. with closer selection.

Local mining men are inquiring into the provisions and purposes of a measure introduced in the State Legislature at Lansing to tax mines according to the actual value of all buildings above ground and all ore mined during the year, instead of on shafts and estimated value of property underground. It is suspected that this is a veiled attempt to enact a law providing a tonnage tax.

NEVADA

NEW BODY OF RICH ORE IN THE FLORENCE MINE IS OPENED.

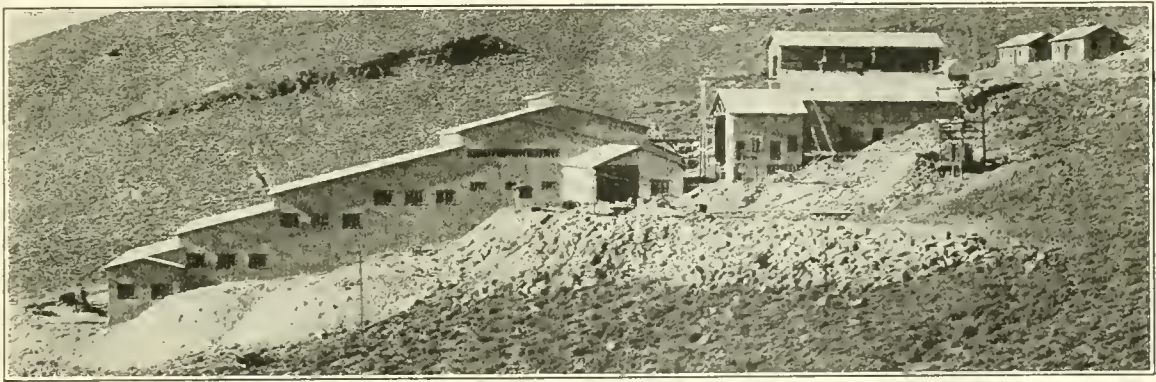
GOLDFIELD.—The vein striking into the hanging wall of the Little Florence east vein that was opened recently in the Cracker Jack lease on the Florence has proved to be a cross-fissure leading to a vein 42 ft. in the hanging wall of the Little Florence east vein. The drift has been driven 20 ft. and the last sample of the face gave a return of \$84, according to R. C. McCarthy, superintendent of the Florence. A winze is being sunk in the cross-fissure. All of this work is being done at a depth of 500 ft. The orebody is the most important found in the Florence since the Florence Divide lease shoot was opened. Barker, Heiden, and Witt, working at a depth of 200 ft., will soon make a carload shipment of ore mined in the hanging wall of the Engineers' vein. Donald and Giles, at a depth of 358 ft. in the Reilly block, have 40 tons of ore saved and they expect to make a carload shipment of

work below the 60-ft. level will be done through the shaft now in use. The terms of the option are said to call for the sinking of a 30-ft. winze. The vein dips at 45° and the shaft is practically at the apex. All of the work to date has been done with hand-drills, but a two-drill air-compressor is in place and machine-drills will be in use in a few days. Harry MacNamara and others took a lease a few years ago and shipped 75 carloads of ore, stopping to within 10 ft. of the surface, 50 ft. from the present stope. Then came the Divide boom and MacNamara took an option on 650,000 shares of stock and re-organized the company into the Golden State. After the boom the Knox Divide took an option from MacNamara.

UTAH

UTAH CONSOLIDATED COMPANY FILES ACCOUNTING FOR ORE WRONGFULLY MINED.

The Utah Consolidated Mining Co., in accordance with



THE ROCHESTER 'COMBINED' MILL AT ROCHESTER, NEVADA

\$20 ore from screening stope-filling. An odd lease on the Consolidated is that of Charles Magee, who says he is making a fair profit in placer mining. He uses a rocker to wash gravel in one of the gulches.

PEAVINE.—A gold-silver-copper orebody 3 to 8 ft. wide has been drifted on for 100 ft. on the 300-ft. level of the Standard Metals.

COALDALE.—Goldfield men who visited the Darms coal mine and took a sample of the 2-ft. vein at a depth of 420 ft. had the coal tested by blacksmiths, who said it was better than the coal costing \$60 per ton they are using now. The coal is of poor appearance, but the blacksmiths say it is ideal for welding purposes, making a good weld and not coking too much. A 10-ft. drift is the only work done in this vein.

MANHATTAN.—The mill of the White Caps is not to be re-opened until mid-summer, instead of on March 1, as was reported, according to the latest official statement on the subject. Three shifts of miners are now employed.

KLONDYKE.—The stope on the 60-ft. level of the Golden State mine of the Knox Divide is 55 ft. long and the ore is being broken over a width of 7 to 11 ft. The stope is now 20 ft. high. Sinking of the winze from this level was discontinued at a depth of 30 ft. and, according to persons at the mine, it is improbable that further

a decree of the United States District Court, has filed an accounting and financial statement setting forth what it believes is the total value of ore extracted from workings of the Utah-Apex Mining Co. It amounts to 117,000 tons, and the Utah Consolidated states it mined and milled this tonnage at a profit of \$658,000. This is only 26% of the \$2,500,000 damages sued for by the Utah-Apex, which sum experts testified in court was a conservative estimate. It is not improbable that exceptions will be taken to this accounting by the Utah-Apex. According to returns filed with the State Board of Equalization, the Utah Consolidated company estimates the value of its properties, for taxation purposes, at \$778,010.

WASHINGTON COUNTY.—At the property of the Silver Reef Consolidated Mining Co. at Leeds, 40 men are now employed, the monthly payroll being \$5000. High-grade ore was found recently in the 'Honest' mine, at a depth of 150 ft., which assays as much as 300 oz. silver per ton. In the 'Robb' mine, the shaft is down to a depth of 200 ft., and is in ore averaging \$28 per ton. Plans are being prepared for working the old tailing at the Barbee mill-site. The tailing dump contains sufficient silver and copper to make it profitable. It is the intention to sink a shaft at the Thompson mine to drain the old workings. In the Leeds mine, an 8-ft. body of ore was cut at a lower

depth than any of the old time workings in that property.

BEAVER COUNTY.—The Leonora Mining Co. drove 400 ft. of drifts, winzes, and raises during 1920. Some additional buildings were erected and machinery installed. The new shaft at the east end of the property was sunk to a depth of 135 ft. Some bunches of high-grade silver-copper ore have been found. Prospecting in the west end of the property resulted in finding ore averaging 7 oz. silver and 6% lead. This deposit has been opened for 60 ft. At the annual meeting of the stockholders, John Matson was elected president; B. H. Goddard, vice-president; H. E. Giers, secretary-treasurer; L. H. Stohr and J. W. Chase, directors.

EUREKA.—Imer Pett, general manager for the Bingham Mines Co., confirms the report of the discovery of ore rich in gold, silver, and lead in a cross-cut about 100 ft. above the 1550-ft. level in the Victoria mine. At the Eagle & Blue Bell, adjoining the Victoria and owned by the same interests, the most important piece of work is a drift being sent out from the 2000-ft. level. It is expected that within the next 300 ft. an ore-channel will be entered. During January these two mines shipped 92 ears of ore, and the February production is expected to exceed this.

All weekly records for ore production in the history of Eureka were broken during the week ending February 12, when a total of 193 ears of ore was shipped. The previous record was a total of 177 ears, made during January 1921. The Tintie Standard shipped 80 ears; Chief Consolidated, 36; Dragon, 19; Iron King, 17; Eagle & Blue Bell, 13; Victoria, 10; Grand Central, 5; Gemini, 4; Centennial-Eureka, 3; Bullion-Beech, 2; Iron Blossom, 1; Eureka Hill, 1; Gold Chain, 1; and Colorado, 1.

BRITISH COLUMBIA

NEW OIL-LEASING REGULATIONS ARE MADE BY CANADIAN GOVERNMENT.

VANCOUVER.—The western branch of the Canadian Institute of Mining and Metallurgy held a successful meeting February 9 to 11. Probably the greatest interest was in a coal symposium, in which many prominent coal-mine operators took part. It is generally felt that the high price of coal in Vancouver and Victoria (\$12 to \$14.50 per ton) is holding back industry and preventing the investment of capital in the Province. Charles Graham, of the Canadian Collieries, Ltd., blamed the present state of the coal-mining industry on Vancouver Island to the extensive use of fuel-oil, claiming that that commodity annually displaced some 600,000 tons of Vancouver Island coal, and at the present price of fuel-oil cost the Province \$6,000,000 yearly, which might better be spent in the development of the coal industry. George Wilkinson gave figures to show that the coal operators were making only about 40c. per ton of coal produced and that the retailers were making \$1.44 per ton of coal sold. He stated that the cost of lump-coal at the bunkers was \$8.71, and the cost of sacking and transportation to

Vancouver was \$1.35. Alexander Sharp, on the other hand, stated that in 1919 of the 2,267,541 tons of coal mined only 4.7% was won by machinery, and to this fact he attributed the high cost of production.

VICTORIA.—The Tidewater Copper Co. has shipped a diamond drilling outfit to its Indian Chief mine, near Sidney Inlet, Vancouver Island. During the cessation of shipping, it is proposed to do considerable exploration with the drill.

The following new regulations governing oil-leases in the Northwest Territories have been received from Ottawa. These supersede all previous regulations and are retroactive to the beginning of the year. They provide for the granting of prospecting licenses for four square miles each, instead of three. In the event of discovery, the licensee will be allowed to take out a 21-year lease for an area of one square mile, the remaining three square miles held under the license reverting to the Government. No prospector is permitted to take out more than five licenses. Each license is for a period of four years, the rental for the first year being at the rate of 50c. per acre, and thereafter at \$1 per acre. An adequate drilling outfit must be installed on the location within two years of the application; drilling to a depth of 500 ft. must be accomplished by the end of the third year, and to 2000 ft. by the end of the fourth year. The penalty for non-compliance with these regulations is automatic forfeiture of license without declaration of cancellation on the part of the Crown.

ONTARIO

BULLION BEING STORED AT COBALT.

COBALT.—There has been little bullion shipped since the beginning of the year, operators hoping for an upward movement in the price of silver and storing their output. The men have apparently accepted without much protest the wage-cut of 75c. per day, which was to go into force on the 15th. They requested a modification of the cut, making the reduction gradual over a period of three months, but the operators declined to reconsider the matter.

The Nipissing during January produced silver to the estimated value of \$139,882 and cobalt valued at \$18,200.

Lateral work at the 410-ft. level of the Chambers-Ferland has opened up a strong vein carrying considerable smaltite. The strike of the vein is directly toward one coming in from the Nipissing and carrying high-grade ore on that property.

Work on the 5th level of the Bailey has opened up the new vein for about 80 ft. The vein averages two inches in width with high-grade ore in patches and three feet of wall-rock on each side is good milling material.

A Government bill now before the Ontario legislature imposing additional taxes on the profits of mining companies is meeting with strong opposition from mining men, as unfair and likely to discourage the investment of capital in the industry. It increases the tax on profits over \$10,000 per year from the present rate of 3% to 4%, and when profits exceed \$1,000,000, from 5% to 7%.



COINAGE OF SILVER DOLLARS RESUMED

The first new silver dollars put in circulation since 1905 were coined at the Philadelphia mint on February 19. This is in pursuance of the terms of the Pittman Act, which provided that the Secretary of the Treasury might melt up and sell a maximum of 350,000,000 silver dollars but that he should purchase sufficient silver to replace the coins. The re-purchase price was fixed at \$1 per ounce and it is this silver, obtained from domestic producers, that is being coined at the present time. Approximately 207,000,000 oz. will be purchased for the purpose.

SERIOUS FIRE AT BROKEN HILL SMELTERS

The 'Financial Times' of London says:
"From the latest cabled advices the fire at the works of the Broken Hill Associated Smelters, situated at Port Pirie, Australia, indicate—although nothing has yet come to hand from any of the companies concerned—that the matter is much more serious than the first message suggested. According to Reuter's Melbourne correspondent, the damage done may reach £250,000, the works may have to be closed for an indefinite period, and it may, therefore, be necessary to suspend productive operations at the famous Broken Hill silver-lead-zinc field of New South Wales. This field has been veritably the sport of fate since the Armistice, for it was only last November that the eighteen months long strike of miners was settled. No sooner did the men return to work than the prices of metals went so low that the mines had to curtail production severely. The one relief to the present situation is that the temporary cutting-off of Broken Hill lead and zinc supplies should accelerate a recovery of the quotations on these metals, and a similar cause may even help the silver quotation. Unfortunately the five leading Broken Hill companies which co-operatively own the smelters are understood to carry their own insurance."

ALLOTING THE EXPORT COPPER

Through its purchase of 400,000,000 lb. of copper the Copper Export Association has become the owner of the greatest tonnage ever under one control. It was bought for re-sale to foreign consumers only and not a pound can be sold for domestic consumption. Although a large number of individual mining companies have membership in the Export Association, the greater part of the business has been in the hands of a committee representing the four largest sales agencies. The contributions to the 400,000,000-lb. pool may thus be summarized:

Agency	Interest, %	Pounds
Guggenheim Brothers	38.90	155,600,000
Anaconda	31.50	126,000,000
Phelps Dodge Corporation	10.90	43,600,000
Calumet & Hecla	6.00	24,000,000
American Smelting & Refining Co.	5.00	20,000,000
United Verde	5.00	20,000,000
Miscellaneous	2.70	10,800,000
	100.00	400,000,000

These figures give an idea as to the proportions in which the country's copper surplus has been held and indicate, furthermore, that when the American Smelting & Refining

Co. at the first of the year turned over to the Guggenheim Bros. its agency business there went with it upward of 200,000,000 lb. of copper.

EARNINGS OF THE INTERNATIONAL NICKEL CO.

Earnings of the International Nickel Co. in the third quarter of its fiscal year ended last December showed the full effects of the industrial depression, profits declining in a sharp manner. These decreased earnings, however, are simply in line with those of other companies, as International Nickel had to absorb inventory losses which, with smaller business, accounts for the relatively poor showing. Starting out in the first three months of its year, the company showed a surplus after preferred dividends of \$1,268,000, and in the second quarter reported \$726,000, a total for the half-year of \$1,994,000. Now for the nine months the surplus after preferred dividends totals but \$2,219,000, indicating that in the three months ended December last the company had a balance of but \$225,000. This severe shrinkage in profits, as pointed out above, may be mostly traced to losses which were absorbed from inventories.

On the outstanding \$41,834,600 common stock the company shows a balance of \$2,219,000, equivalent to \$1.33 per share on a par value of \$25, or 5.32%. Based on the results up to last December earnings for the common stock were running at the annual rate of \$1.76 per share. In view of the general depression which exists at the present time it is not to be expected that the above sum will be realized. While optimistic prospects were held out early last year for the resumption of common dividends, recent events have, for the time being, made this expected action remote.

COPPER PRODUCTION OF THE PORPHYRY COMPANIES

Official estimates place the January production of seven of the prominent 'porphyry' companies at 28,042,744 lb., a drop of 6,819,040 lb., or 20%, as compared with January 1920, and of \$11,659,516 lb., or 29% decrease, as compared with that month of 1919. In December of last year these same producers turned out 28,535,579 lb. New Cornelia was largely responsible for the January increase over December, the other companies making practically unchanged production for both months. The combined monthly production of this group of companies in January averaged at the rate of but 336,504,000 lb. per annum, or about 50% of combined production during the last war year, when these companies turned out 627,832,000 lb., and compares with 407,328,000 lb. in 1919, and 422,137,000 lb. last year.

The following figures show the production of refined copper during January of the past three years, the figures being in pounds:

	1921	1920	1919
Chino	2,999,751	3,081,937	4,241,000
Inspiration	5,000,000	7,200,000	6,500,000
Miami	4,389,993	4,461,247	5,273,260
Nevada Con.	3,000,000	4,181,938	4,400,000
New Cornelia	2,170,000	3,354,000	4,318,000
Ray	2,983,000	3,889,073	4,470,000
Utah	7,500,000	8,693,589	10,000,000
Totals	28,042,744	34,861,784	39,702,260

HEARINGS ON FREIGHT-RATES ON COPPER FROM UTAH TO PACIFIC PORTS

Final arguments were completed on February 17 at Salt Lake City in the hearing conducted by examiners of the Interstate Commerce Commission to determine the reasonableness of the rate of \$6.20 per ton on copper ingots from Utah points to San Francisco, where it is to be loaded on boats for shipment to the Atlantic seaboard by way of the Panama Canal. The rate was published in December, but the Interstate Commerce Commission ordered it withdrawn, pending a hearing. It is stated that the Commission will file its order in the matter on or before April 29. If the rate is allowed to stand, it will result in a saving of \$6 or \$7 per ton over the present all-rail route to New York.

ARIZONA

Jerome.—It has been announced that sufficient capital has been secured to continue exploration at the Shea mine. The shaft is to be sunk to the 1000-ft. level and the orebodies cut in the tunnel on the 535-ft. level are to be developed.

Kingman.—F. P. Aylwin and associates have taken over the Amerlean Flag mine and operations are to commence immediately. The deposit was discovered in 1876 by William Shoulters who sunk a 60-ft. shaft and shipped ore to Wales. He later sold the mine for \$25,000. The property was then developed to the 250-ft. level and over \$400,000 in silver was taken out and shipped to Wales.—Kent Keller has adjusted all the litigation concerning the title of the old White Hills mine in the Cerbat range and expects to open the mine soon. The White Hills mine was operated continuously for nine years in the 'nineties by an English company that erected a 40-stamp mill and, it is reported, took out over \$6,000,000 in silver.

Phoenix.—Upon his return to the Relief gold mine property, 25 miles north-west of here, George Hammond, superintendent, discovered that several large frame buildings, the hoist, steam-engine, and hoist-house had all been stolen from the property. Large motor-trucks had, apparently, been used for the purpose.

Tombstone.—It is announced by James Kelly that following an examination of his silver-manganese property in Miller canyon in the Huachuca mountains by Eastern capitalists, a company is to be formed immediately to take over his group of claims and an adjoining group. The property has been worked in a small way for a number of years.—The number of mines working in the Tombstone district has increased in the last six months. Many of the old properties are being worked by lessees and are reported to be doing well. At present four mills are being re-built or are under repair. Joe Rest is erecting a small mill on his claims and the Old Guard mill is being overhauled preparatory to starting up next month. A new mill is being erected by lessees near the State of Maine mine and Bert Holland's new mill is expected to be started immediately.

CALIFORNIA

Calaveras County.—It is reported that a 6-ft. vein of gold-bearing quartz has been uncovered on the 200-ft. level of the Angels Camp Deep mine. A cross-cut is being driven on the 500-ft. level to intercept the same vein. The head-frame at the shaft is being repaired and the stamp-mill is nearly ready for operation.—The downward continuation of the productive 'Flat' lode has been found on the 1150-ft. level of the Carson Hill mine. The orebody recently opened on the 1600-ft. level contains good milling ore over a width of 12 to 15 ft. The 10 additional stamps recently started will bring the capacity of the mill to 500 tons per day, when it is expected that lower-grade ore can be profitably treated.

Eldorado County.—The orebody recently opened on the 250-ft. level of the Buckman mine, being operated by the Grit Mining Co., proves to be a valuable discovery. Milling

machinery is being sent to the property.—The Eldorado Mines Association has been formed with the object of settling litigation that has hampered operations in the district for many years.

Nevada County. The inclined portion of the Idaho-Maryland shaft at Grass Valley has been unwatered to within 200 ft. of the bottom. The company is said to have completed arrangements for developing the Grasshopper claim, in which the extension of rich veins is expected to be found.—The largest production since the curtailment during the War is being made by the North Star company. The central mill is running steadily.

Placerville.—The Pacific Channel mine, 18 miles east of here, is being developed by J. E. Sexton, of Palisade, Nevada. An adit is being driven that has opened the channel for a distance of 150 ft., the gravel containing as much as \$1 per yard in gold.

COLORADO

Central City.—The Cornucopia Leasing, Mining & Milling Co. is developing two strong veins that are thought to be an extension of the Perigo vein system. John Havens, of Denver, is president of the company.—The Buell plant, of the American Mines & Development Co., is being overhauled and will resume operation about March 1. Ore from the East Boston mine will supply the mill.

Debeque.—Shale-oil is being successfully retorted at the plant of the Mount Logan Oil Shale Co. Two other plants in the vicinity are reported to be nearing completion. The Monarch Oil Shale Co. and the Index company both have plants nearly ready to operate. Carl Schuyler is erecting a plant near Grand Valley, Colorado.

Denver.—Public hearings, investigating the affairs of the Colorado School of Mines at Golden, are being held before a joint Legislative committee. The hearings are open to the public. Victor C. Alderson, president, against whom most of the criticism has been directed, answered the charges made against his administration.

Leadville.—Following the issuance of a charter for the Leadville Mine Development Co. by the Secretary of the State, Leadville citizens are responding liberally and \$8000 was subscribed in the first two hours, when John Cortellini passed the subscription list. The following men have been elected directors: Jesse F. McDonald, former governor, Ezra D. Dickerman, John Cortellini, William Harvey, and Joseph W. Clarke. Martin Kieff, of the firm of Platt & Kieff, has been engaged to survey the tunnel site, and the starting of the tunnel to tap the expected wealth of Prospect mountain and Canterbury hill, will start soon.

IDAHO

Coeur d'Alene.—The Reed Level Mining Co. is employing 25 men in mining and milling operations. The company was formed by consolidating the interests of the Co-operative mill at the entrance of the Reed adit to the Bunker Hill & Sullivan mine, and the holdings of a number of the lessees, granted them upon the upper workings of the mine. Improvements made in the mill consist of a flotation unit adequate to handle the slime derived from concentrating 200 tons of ore daily. An apparatus has been installed that dries slime concentrate by rabbling over a steam-heated manifold. Three stopes are being worked, producing 60 tons of ore per day.—The Western Union Mining Co., controlled by Spokane men, has just received a return of \$2544 per car on six carloads of ore sent to the East Helena smelter. The property is situated in Revenue gulch, two miles north-west of Wallace, and is being operated by lessees under a 25% royalty. A body of high-grade silver-lead ore has been blocked out.—On account of high freight-rates from Kellogg to the Eastern seaboard the Bunker Hill smelter is now shipping pig-lead to New York by way of Seattle and

the Panama Canal. Recently 1000 tons of pig-lead from the Bunker Hill was loaded at Seattle, and, unless there should be a substantial reduction on the bullion rate to the East by the railroads, officials of the company state that shipments by way of the canal will continue. The Bunker Hill company is the first to ship lead by water. Native silver in a rich vein of ore has been found in the Bluebird property on Blacktail mountain. The ore is similar to that on the Jim Evans property near by.—A three-mile wagon-road in the Idaho-Northern property, north of Murray, has been completed. When the compressor is installed a crew of men will start driving the adit on the property forward 1600 ft. to cross-cut the vein. When the vein is intersected a depth of 1000 ft. will be secured.—Development of the property of the St. Louis & Idaho Mining Co., near Burke, is to be resumed during the coming spring. Development work already done at the property consists of 1900 ft. of underground workings. No. 1 tunnel was run in 600 ft., disclosing considerable ore of fair grade.—Eight carloads of mining machinery, including a 50-ton ball-mill, large compressor, flotation plant, motors, and mine-cars, now at the Empire Copper mine, have been purchased by Fred Lee of the Hallidie Machinery Company, of Spokane. Work of dismantling will be started at once. The property is better known as the Horst-Powell.

MONTANA

Adair.—The Montana-Idaho Copper Co. is extending a 7000-ft. prospect-tunnel, which ultimately will attain a length of 9000 ft. The company has taken over the property formerly owned by the Monitor Mining Co., consisting in all of 44 claims. Ore assaying 15% copper and \$5 gold per ton was shipped by the Monitor company.

Butte.—Anaconda now has workings in practically contiguous property along the strike of the great vein system for a distance of about six miles, in consequence of its acquiring a joint ownership with Beer, Sondheimer & Co., in the latter's Missoula gulch territory, which is situated in the west-central part of the district.—Operations at the No. 3 shaft of the Black Rock mine are giving promise of a large tonnage, comparable with that had on the upper levels. This shaft is being sunk in the Rainbow vein, which dipped into the shaft below the 2400-ft. point. Butte & Superior has about 50 men engaged in development and improvement work.—East Butte is operating but one shift in its Pitts-mont mine and one furnace in its smelting plant. The proposed curtailment of operations in its flotation plant from seven to five days weekly is not due to a reduction in its own production, but is the result of the curtailment put into effect by the Davis-Daly Copper Co., which has reduced its daily output from 300 to 200 tons. The capacity of East Butte's flotation mill is 600 tons per day.

Helena.—A new law, signed by the Governor, makes it obligatory on owners of mines to settle with lessees on their properties within seven days after returns have been received from the smelter. A penalty of 10% of the net returns is imposed. It is said that some lessors have waited as much as six months before making settlements with their lessees. The same bill requires that the owner furnish the lessee with an accurate copy of the smelter returns.

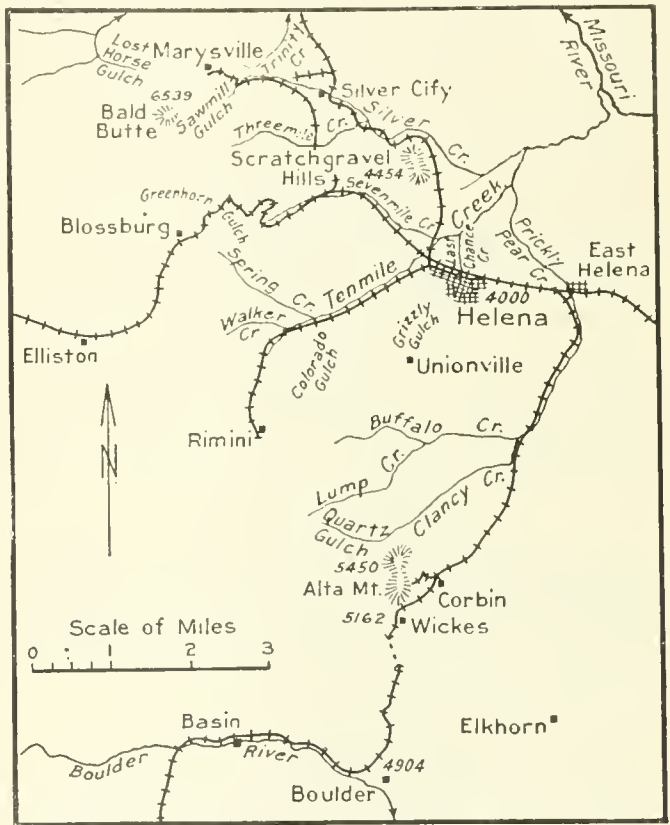
Neihart.—At the Hartley mine a 2-ft. vein of ore assaying 80 oz. of silver per ton and containing \$15 in gold has been discovered. The ore is peculiar for the reason that most of the ores of the district contain little of any valuable metal other than silver and lead.

Scratch Gravel.—J. L. Howard, of Spokane, has acquired a number of claims. Three of these—the Champion, Silver Edge, and Aster—have produced rich ore. The other claims, known as the Benton, Defender, Alabaster, and Stark, are likely prospects. The ore is low-grade lead-silver, with some copper.

Sildix.—Good progress is being made in unwatering the 400-ft. shaft of the Amazon-Dixie mine. The shaft will be sunk an additional 400 ft. Likewise a 2000-ft. adit will be extended into the Leslie Grant, which was recently acquired by the Amazon-Dixie company. Eighteen men are employed at the property.

NEVADA

Eureka.—High-grade ore on the 400-ft. level of the Eureka-Holly mine is reported. The discovery was made several hundred feet from the known ore-shoots. The volatilization furnaces at the Holly reduction plant are completed. A trial run will be made at once.—D. States reports that progress is being made in driving the main tunnel of the Uncle Sam Consolidated. The vein in the upper workings contained ore worth \$160 per ton. As many miners as can conveniently work in the tunnel are employed.—A



HELENA, MONTANA, AND NEIGHBORING MINING DISTRICTS

drift from No. 8 winze of the Eureka-Croesus has exposed ore for a distance of 25 ft. This ore is found on a lower horizon than any of the old or recent shoots in the mine.

Gold Circle.—The Elko Prince has opened a shoot of ore for a distance of 100 ft. on a vein measuring from 20 in. to 4 ft. wide. The ore averages \$200 per ton.—Berry Brothers have exposed a 6-ft. vein of \$115 ore at a depth of 220 ft. in the Big Chief group.—The extension of the electric-power line from Battle mountain is projected and it is hoped to have the line built this year.

Good Springs.—The experiments being conducted by the Bureau of Mines, at Salt Lake City, on ore from the Yellow Pine mine show that 94% of the silver and 80% of the lead can be obtained by use of the chloride-volatilization process. Experiments on a large scale at the plant here have verified laboratory tests.

Osceola.—Gold ore assaying from \$50 to \$60 has been found on the Crescent claim and is being worked by James and Jack Merritt. The ore was opened in a winze from the main tunnel. Osceola was at one time one of the richest gold-producing districts in Nevada.

OKLAHOMA

Picher.—A fund is being raised for the purpose of relieving suffering among the families of miners who have been thrown out of employment by the recent shut-down. The local sections of the American Zinc Institute and the American Mining Congress are co-operating in the work. Steps are being taken to afford employment on road building and other public work pending the revival of activity in mining, which is contingent upon improved prices for the metal. Development work is being done on a curtailed scale.

OREGON

Medford.—Under the initiation of Henry M. Parks, of the Oregon State Bureau of Mines, a meeting of mining men from the Blue Ledge district in north-western California and south-western Oregon, Gold Hill, Jacksonville, and the Applegate districts in Oregon, was held on February 11. The meeting was devoted to an open discussion of ways and means for continuing the existence in a revised form of the War Minerals Relief Commission, which under present rulings will terminate with the current administration. With this in view, resolutions were adopted favoring prompt action on a bill passed by the Senate and awaiting action of the House of Representatives, which provides for continuance of the War Minerals Relief Commission with revised scope of authority which would allow appeals from the action of the Commission to be made to the United States Court of Claims. The meeting went on record as opposed to the dilatory and entirely unsatisfactory methods by which the present War Minerals Relief Commission handled the claims presented from this particular section. An informal discussion on the possibilities for a protective tariff on manganese and chrome minerals brought out the fact that the local mining opinion was strongly in favor of such legislation.

WASHINGTON

Spokane.—The Northwest Mining Convention, to be held at Spokane, Washington, February 28 to March 5, is expected to be the largest ever held. A special committee has been appointed to make the visitor's stay in this city one to be remembered. Theatrical parties, luncheons, and various other entertainments are being arranged for the comfort of the visitors.

MEXICO

Chihuahua.—H. Sulliger, manager for the Dolores Mines Co., has returned from a trip to the Mineral de Dolores, west of Temosachic, in the Guerrero district, near the border line between Chihuahua and Sonora. The corporation represented by Mr. Sulliger intends to invest \$1,500,000 in the erection of a new mill at Dolores and in a power-plant at Madera, also starting the operation of the rich gold-silver mines in that mining camp. The wagon and automobile road between Dolores and Madera station has been repaired and is ready for traffic.

Guanajuato.—The Guanajuato Consolidated Mining Co. has decided to shut-down its mines and mills pending an improvement in the market for metals. About 400 men will be thrown out of employment.

ONTARIO

Porcupine.—During 1920 the Hollinger Consolidated Gold Mines Co. produced \$6,932,628 as compared with \$6,722,267 in the preceding year. After payment of dividends, the surplus remaining was \$461,275 as compared with \$1,232,109 in 1919.——The new part for the underground crusher at the Dome mine has been received and put in place. This single piece weighed nine tons and its replacement makes possible the supply of mill-ore at the maximum capacity. It is expected that the supply of hydro-electric power will be plentiful as soon as the weather breaks, and production should then be increased.

PERSONAL

The Editor invites members of the profession to send particulars of their work and appointments. The information is interesting to our readers.

Edgar Rickard is at Duluth.

Philip Argall is in Washington.

F. M. Mechling is here from Tonopah.

Morton Webber is at the Palace Hotel.

Algernon Del Mar is at Nayarit, in Mexico.

E. Coppes-Thurston is at the Hotel Darby, Los Angeles.

Thomas B. Stearns, of Denver, is expected here this week.

Geo. Watkin Evans, of Seattle, was in San Francisco last week.

Charles R. Keyes, of Des Moines, is on his way to the west coast of Mexico.

Arthur Winslow sails on February 28 from Boston for Liverpool on his way to Spain.

Frank G. Janney and Charles W. Stimpson, both of Salt Lake City, were here last week.

F. R. Raliff, traffic manager for the American Smelting & Refining Co., is at Salt Lake City.

D. D. Moffat has returned to Salt Lake City after a trip to the Mesabi Iron property in Minnesota.

Philip Wiseman has been elected a vice-president of the Chamber of Mines and Oil, at Los Angeles.

George W. Heinz, of the United States Smelting, Refining & Mining Co., has arrived here from Boston.

Charles N. Edge, of New York, is visiting his mine at Chinese Camp, on the Mother Lode, California.

H. D. Pallister has been appointed Professor of Mining in the School of Mines of the University of Alabama.

William Frecheville, formerly Professor of Mining at the Royal School of Mines, London, was in New York last week.

C. B. Lakenan, general manager for the Nevada Consolidated Copper Co. at McGill, was at Salt Lake City recently.

Sherwood Aldrich, president of the Ray Consolidated Copper Co., is making an extended trip to Japan, China, and the Philippine Islands.

H. W. Edmondson left New York on February 19 for Mexico, where he will make an examination of the Rio Plata mine, at Guazapares, Chihuahua.

Walter Fitch, president of the Chief Consolidated Mining Co. at Eureka, Utah, is in southern California. Cecil Fitch, manager for the same company, is at Honolulu.

H. C. Bellinger, vice-president of the Chile Copper Co., and Fred Hellman, consulting mining engineer for Guggenheim Brothers, were in Utah recently, visiting metallurgical plants.

William E. Colby has returned from Kingman, Arizona, where he argued the case of the plaintiff in the apex suit, Tom Reed v. United Eastern. John P. Gray, of Coeur d'Alene, represented the defendant.

Ralph R. Woolley, hydraulic engineer with the U. S. Geological Survey at Salt Lake City, is in Washington. He has been collecting data for a publication on the 'Water Powers of the Great Salt Lake Basin', to be published by the Survey.

J. C. Dick, chief of the sub-division of natural resources of the Internal Revenue Income Tax Unit at Washington, D. C., has resigned, effective March 31. Mr. Dick will resume his profession of consulting mining engineer at Salt Lake City. His successor is C. F. Powell, of Oklahoma City.

THE METAL MARKET



METAL PRICES

San Francisco, February 21

Aluminum-dust, cents per pound.....	65
Antimony, cents per pound.....	8.00
Copper, electrolytic, cents per pound.....	13.25-13.75
Lead, pig, cents per pound.....	4.65-5.65
Platinum, pure, per ounce.....	\$70
Platinum, 10% iridium, per ounce.....	\$100
Quicksilver, per flask of 75 lb.....	\$47.50
Spelter, cents per pound.....	8.25
Zinc-dust, cents per pound.....	12.50-15.00

EASTERN METAL MARKET

(By wire from New York)

February 21.—Copper is inactive but easy. Lead is dull and lower. Zinc is lifeless but easy.

SILVER

Below are given official or ticker quotations for silver in the open market as distinguished from the fixed price obtainable for metal produced, smelted, and refined exclusively within the United States. Under the terms of the Pittman Act, such silver will be purchased by the United States Mint at \$1 per ounce, subject to certain small charges which vary slightly but amount to approximately three-eighths of one cent. The equivalent of dollar silver (1000 fine) in British currency is 46 65 pence per ounce (925 fine), calculated at the normal rate of exchange.

Date	New York cents	London pence	Average week ending Cents	Pence
Feb. 15.....	60.25	34.87	Jan. 10.....	66.60 41.56
" 16.....	59.50	34.00	" 17.....	66.14 40.00
" 17.....	60.00	34.75	" 24.....	66.56 39.94
" 18.....	58.25	33.87	" 31.....	64.52 38.16
" 19.....	57.62	33.75	Feb. 7.....	61.66 36.13
" 20 Sunday			" 14.....	61.70 36.32
" 21.....	57.25	33.00	" 21.....	58.81 34.04

Monthly averages

Date	1919	1920	1921	1919	1920	1921
Jan.	101.12	132.77	65.95	July	106.36	92.04
Feb.	101.12	131.27	...	Aug.	111.35	96.23
Mch.	101.12	125.70	...	Sept.	113.92	93.66
Apr.	101.12	119.56	...	Oct.	119.10	83.48
May	107.23	102.69	...	Nov.	127.57	77.73
June	110.50	90.84	...	Dec.	131.92	64.78

COPPER

Prices of electrolytic, in cents per pound.

Date	Average week ending
Feb. 15.....	13.00
" 16.....	13.00
" 17.....	12.75
" 18.....	12.75
" 19.....	12.75
" 20 Sunday	
" 21.....	12.75

Monthly averages

Date	1919	1920	1921	1919	1920	1921
Jan.	20.43	19.25	12.94	July	20.82	19.00
Feb.	17.34	19.05	...	Aug.	22.51	19.00
Mch.	15.05	18.49	...	Sept.	22.10	18.75
Apr.	15.23	19.23	...	Oct.	21.66	16.53
May	15.91	19.03	...	Nov.	20.45	14.63
June	17.53	19.00	...	Dec.	18.55	13.18

LEAD

Lead is quoted in cents per pound, New York delivery.

Date	Average week ending
Feb. 15.....	4.70
" 16.....	4.55
" 17.....	4.55
" 18.....	4.50
" 19.....	4.40
" 20 Sunday	
" 21.....	4.40

Monthly averages

Date	1919	1920	1921	1919	1920	1921
Jan.	5.60	8.65	4.96	July	5.53	8.63
Feb.	5.13	8.88	...	Aug.	5.78	9.03
Mch.	5.24	9.22	...	Sept.	6.02	8.08
Apr.	5.05	8.78	...	Oct.	6.40	7.28
May	5.04	8.55	...	Nov.	6.76	6.37
June	5.32	8.43	...	Dec.	7.12	4.76

TIN

Prices in New York, in cents per pound.

Date	1919	1920	1921	1919	1920	1921
Jan.	71.50	62.74	35.94	July	70.11	49.29
Feb.	72.44	59.87	...	Aug.	62.20	47.60
Mch.	72.50	61.92	...	Sept.	55.79	44.43
Apr.	72.50	62.17	...	Oct.	54.82	40.47
May	72.50	54.99	...	Nov.	54.17	36.97
June	71.83	48.33	...	Dec.	54.94	34.12

ZINC

Zinc is quoted as spelter, standard Western brands, New York delivery, in cents per pound.

Date	Average week ending
Feb. 15.....	5.35
" 16.....	5.35
" 17.....	5.35
" 18.....	5.35
" 19.....	5.35
" 20 Sunday	
" 21.....	5.35

Monthly averages

Date	1919	1920	1921	1919	1920	1921
Jan.	7.44	9.56	5.86	July	7.78	8.18
Feb.	6.71	9.15	...	Aug.	7.81	8.31
Mch.	6.53	8.93	...	Sept.	7.57	7.84
Apr.	6.49	8.76	...	Oct.	7.82	7.50
May	6.43	8.07	...	Nov.	8.12	6.78
June	6.91	7.92	...	Dec.	8.69	6.03

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, according to quantity. Prices, in dollars per flask of 75 pounds.

Date	1919	1920	1921	1919	1920	1921
Jan. 25.....	50.00	50.00	...	July	100.00	88.00
Feb. 1.....	50.00	50.00	...	Aug.	103.00	85.00
				Sept.	102.60	75.00
				Oct.	86.00	71.00
				Nov.	78.00	56.00
				Dec.	95.00	52.50

Monthly averages

Date	1919	1920	1921	1919	1920	1921
Jan.	103.75	89.00	50.00	July	100.00	88.00
Feb.	90.00	81.00	...	Aug.	103.00	85.00
Mch.	72.80	87.00	...	Sept.	102.60	75.00
Apr.	73.12	100.00	...	Oct.	86.00	71.00
May	84.80	87.00	...	Nov.	78.00	56.00
June	94.40	85.00	...	Dec.	95.00	52.50

MOVEMENT OF GOLD AND SILVER

Imports of gold into the United States for the calendar year totaled \$428,700,000, compared with \$76,500,000 for the calendar year 1919, while gold exports aggregated \$322,100,000, against \$368,200,000 exported in 1919, according to Federal Reserve Board estimates announced on February 15. Practically no change for the year was shown in gold-reserves of Federal Reserve banks, notwithstanding the record volume of gold shipments.

Silver imports in 1920 totaled \$88,100,000, compared with \$89,400,000 in 1919, while silver exports for the year were \$133,600,000, compared with \$239,000,000 exported during the preceding year. Net silver exports for the year totaled \$25,600,000 against \$149,600,000 in 1919. More than 60% of the incoming silver shipments was mined in Mexico, while an additional 13% came from Peru. Of the total silver exports for the year, more than 84% was consigned to the Far East, China receiving more than one-half of the total outgoing shipments, while British India was another big consignee.

THE PRICE OF REFINED OIL

A prominent oil-refiner says no radical reduction in the price of refined oil is expected for several months. Some refiners carry stocks of crude oil five and six months ahead, many at least a three months' supply. This oil has been purchased at high prices, and until these stocks are disposed of no material reduction in prices of the products is expected. The labor situation is more important in refining than in production, and wages have not gone down materially in refining from the high mark of 1920. Although demand for oil products is not large, refiners are expecting a heavier demand shortly, probably by April.

BRITISH GOLD PRODUCTION

A preliminary report on gold production of the British empire for 1920 in the 'Mining Journal' of London shows a general decline, as compared with the output of the previous year. The Transvaal, Western Australia, Rhodesia, India, Queensland, and New South Wales reported decreased production while Victoria's output was 152,702 oz. as compared with 135,427 oz. in 1919. The grand total for all British goldfields is given as 10,091,078 oz. in 1920.

A proclamation dated February 7, 1921, prohibits the exportation of gold and silver coin and gold bullion from the United Kingdom except under license from the British Board of Trade, states a consular report. Gold produced in British Dominions and imported into the United Kingdom may, however, be exported in accordance with the terms of such arrangements. Gold bullion includes gold partly manufactured and any mixture or alloy containing gold.

MALAY GOVERNMENT FIXES PRICE OF TIN

Owing to the constantly fluctuating price of tin, the government of the Federated Malay States, says a consular report, has made arrangements to purchase tin at \$110, local currency, per picul of 133 1/3 lb. The Straits Trading Co. and the Eastern Smelting Co. are to act as purchasing agents on behalf of the Government. It should be noted that this price does not refer to tin ores but to smelted tin only and will vary as conditions change.

MONEY AND EXCHANGE

Foreign quotations on February 21 are as follows:	
Sterling, dollars:	Cable 3.89
	Demand 3.90
Francs, cents:	Cable 7.30
	Demand 7.33
Lire, cents:	Demand 3.70
Marks, cents:	..... 1.69

Eastern Metal Market

New York, February 16

There is little animation to any of the markets, but an optimistic tone is evident in nearly all. Prices are fairly firm to steady in most cases.

The copper market is stronger after the settlement of the project to finance the surplus stocks.

The tin market is moderately active with prices fairly steady.

Demand for lead is only light with the price tendency downward, if anything.

There is still almost no buying of zinc, but prices are fairly steady.

IRON AND STEEL

The price developments reveal a further downward tendency. Steel is obtainable \$5 below the Steel Corporation levels and basic pig-iron has also sold at lower levels. The effect has been to postpone further buying of steel and also to curtail operations. In fact it is probable that actual buying is below one-fourth of the country's capacity.

There is no prospect of any early revival. Production will probably recede rather than advance in the next few weeks. General conditions are, however, regarded favorably and optimism as to the future is not wanting.

Wage reductions continue, but not by the Corporation. In the Youngstown district a 20% reduction has been announced.

Finished steel and some semi-finished is now to be secured quite generally at \$5 per ton under the Steel Corporation prices. In steel-making pig-iron, basic has sold \$5 down or at \$25, Valley.

In the export market the feature is the continental competition for the present small volume of business.

COPPER

There has been a distinct improvement in inquiry and the market is gradually developing a considerably firmer tone. This is due probably to the announcement of the successful financing of the copper surplus of 400,000,000 lb. by the sale of debentures amounting to \$40,000,000. This virtually removes this large quantity from the market so far as its being a drag, for it is held largely for export and is to be sold at not less than 12.50c. per pound. Quotations for electrolytic copper are firm at 13 to 13.25c., delivered, with some producers asking 13.25c. as a minimum. Lake copper is firm at 13.50 to 13.75c., delivered. There is an inquiry for 2000 tons from Italy and various consuming interests, who evidently are commencing to feel the market, represent requirements up to 9,000,000 lb., the bulk coming from brass-making interests.

TIN

Interest in this market has fallen to a low ebb. The market is quiet, almost to stagnation. Whereas dealers were buyers recently, they are now uninterested and so are consumers. It is now confirmed that the Malay government has reduced its minimum price to £203 at which it will purchase metal from producers. The New York market for spot Straits has hung close to 33c. the past week, the quotation yesterday having been 32.50c., New York, with almost no business to establish a market. London, however, is higher than a week ago by £6 to £8 per ton. Spot standard was quoted yesterday at £170 per ton, future standard at £173 10s., and spot Straits at £190. Arrivals thus far this month have been 1520 tons with 2225 tons reported afloat.

LEAD

Apparently the present demand can easily be satisfied with metal at 4.70c., New York, or 4.35c., St. Louis, which

are the levels in the outside market. The market is quiet and extremely dull and devoid of new features. The leading interest continues to quote 4.75c., New York and St. Louis, a level it has maintained for a month or two. Production in lead is now heavier than market conditions really warrant because of the price of silver, which makes it profitable and desirable to work some mines that otherwise could not be operated now.

ZINC

This market continues its listless lifeless course. Sales are small and confined to the immediate needs of regular customers. Despite the lack of improvement prices remain fairly firm at 5c., St. Louis, or 5.50c., New York, for the domestic metal, while imported zinc is quoted at 5.35c., seaboard. Reduction in production is reported as progressing further. Prospects for the future are not encouraging as to a renewal of normal activity.

ANTIMONY

There is no change in this market, wholesale lots for early delivery being quoted at 5.25c., New York, duty paid, with jobbing lots about 1c. per pound higher.

ALUMINUM

Virgin metal in wholesale lots from the leading producers is quoted at 28.20c. per pound f.o.b. plant, while the same grade from other sources, handling the foreign metal, is obtainable at 24 to 25c. per pound, New York.

ORES

Tungsten: No improvement is reported and the market remains unchanged. Offerings of ore at \$2.75 to \$3 per unit are noted but there have been no sales.

Ferro-tungsten is quoted at 58c. per pound of contained tungsten, guaranteed as to quantity; the non-guaranteed material is held at 38c. Powdered tungsten is quoted at 70 to 77c. per pound of contained metal.

Molybdenum: Quotations continue nominally unchanged at 60c. per pound of MoS₂ in regular concentrate. There is no demand.

Manganese: The market is devoid of feature or demand with quotations nominal at 35 to 40c. per unit, seaboard, for high-grade ore.

Manganese-Iron Alloys: Ferro-manganese can be obtained now from American producers at \$100, delivered, while the British alloy is quoted at \$100, seaboard, but there is no demand to test the market, except an inquiry for export of 600 tons to Japan with little prospect of a sale. Spiegeleisen is quoted at about \$40, furnace, with sales of about 150 tons noted.

WAR DEPARTMENT WILL DISPOSE OF BRASS

The War Department will soon probably announce disposition of 56,000,000 lb. of brass, for which it received 50 bids recently. Brass is composed of two parts of copper and one part of zinc, so that the metal content of the above quantity would approximate 19,000,000 lb. of zinc and 37,000,000 lb. of copper.

The big quantities of brass, either new or 'junk', which have been available here and in Europe since the Armistice have been a handicap with which the copper producers have had to contend. During the past year over 100,000,000 lb. of brass was bought by American manufacturers abroad and brought back here to be re-melted. Both the War and Navy departments have also from time to time offered surplus stocks of brass on the market, thereby affecting detrimentally the market for the constituent metals.

Book Reviews

Coal Washing. By Ernst Procaska. 382 pp., 5½ by 8 in., 202 ill. McGraw-Hill Book Co., Inc., New York. For sale by 'Mining and Scientific Press'. Price, \$4.

A systematic description of modern practice in the art of coal-washing, containing the necessary information to enable the coal-operator to choose the apparatus and adopt the methods best adapted to his requirements.

Electrolytic Deposition and Hydrometallurgy of Zinc. By Oliver C. Ralston. 210 pp., 6 by 6 in., 46 ill. McGraw-Hill Book Co., New York. For sale by 'Mining and Scientific Press'. Price, \$3.

This book has been written to describe present practice and the theory underlying the leaching of zinc ores, and the purification and the electrolysis of solutions. The author, who is metallurgist with the Hooker Electrochemical Co., of Niagara Falls, discusses the history of zinc hydrometallurgy, the roasting of zinc ores, leaching, purifying and electrolysis, chlorinating zinc ores, the electrolysis of zinc chloride, electrolytic zinc refining, melting electrolytic zinc, and the economics of zinc hydrometallurgy. A number of examples of current practice are described; and although the process is at an early stage of development the treatise will be welcomed as a useful guide to those interested in the subject.

Labor's Crisis. By Sigmund Mendelsohn. 171 pp. The Macmillan Co., New York. For sale by 'Mining and Scientific Press'. Price, \$1.50.

The sub-title of this book is 'An Employer's View of Labor Problems'. It consists of about twenty-five essays on various economic and sociological subjects ranging from 'Poverty, Its Nature and Effect' to 'Can Reduced Hours Advance the Welfare of Labor and of Society?' The author expresses opinions both on controversial questions and on questions on which there is general agreement. These opinions are supported by some statistics, but, otherwise, there is nothing in the body of the book or elsewhere to explain why the author reached his conclusions. Herein, rather than in the text itself, lies the chief weakness of the book. It can be recommended only to those who would like to read the unsupported conclusions of a man without any general reputation.

Applied Colloid Chemistry. By Wilder D. Bancroft. 345 pp., index. McGraw-Hill Book Co., Inc., New York. For sale by 'Mining and Scientific Press'. Price, \$3.

Professor Bancroft has succeeded remarkably well in collecting and classifying over fifteen hundred extracts from the writings of nearly one thousand authorities and investigators on practically every phase of colloid chemistry. The extracts have been arranged in orderly sequence and, in combination with subject matter introduced by the author, form a valuable contribution to the available literature on the subject. In his introduction, the author deals with the advance in the conception of colloidity, pointing out that a colloidal state is now usually referred to, and not a colloidal substance. Ostwald's definition is quoted in which the contention is advanced that a phase may be termed colloidal provided it is sufficiently finely divided or dispersed, without definite commitment as to what degree of subdivision is necessary in any particular case. In Chapter I the author deals with the adsorption of gas or vapor by solid. Many interesting data have been collected on the adsorption of various gases by charcoal, a subject brought to the front during the War by the need for efficient equipping of masks to purify air containing poisonous gases. Several of the

principal contact processes are also described. In Chapter II, other types of adsorption are considered, followed by a chapter on adsorption from solution, which contains a reference to a book of Defoe's in which mention was made of the 'filtering' of alkaline water by means of sand—an early record of an adsorbent effect. Surface-tension, the Brownian movement, and coalescence are considered in detail. Data on the preparation and properties of colloidal solutions have been classified and presented in condensed form. The book concludes with chapters on gelatinous precipitates and jellies, emulsions and foams, fog and smoke, gases and solids in solids, and the thickness of surficial films.

Revision for a second edition will doubtless disclose the fact that an abnormal number of compositor's errors on p. 312 have escaped the notice of the proof-reader. The adoption of the recognized abbreviation for 'gram' (gm.) is to be recommended. On p. 26, for instance, the abbreviation 'g', with and without the period, is used. The result of the innovation is that on p. 28 we read that "R. B. Loeb³ finds that the adsorption of methyl alcohol vapor by 0.41g platinum black causes . . ." Coco-nut, a word that occurs frequently, is mis-spelled cocoanut, inviting confusion with 'cocoa', with which it has no connection. Such criticisms, however, may be deemed captious; but they indicate at least that minor points only are alluded to and so emphasize the fact that the book is timely and reliable, its preparation evidently involving a considerable amount of labor. It should prove of value to the technician as well as to the student.

A. W. A.

Recent Publications

Structure in Paleozoic Bituminous Coals. By Reinhardt Thiessen. Bull. 117, Bureau of Mines, 1920. 296 pp., index, ill.

The Data of Geochemistry. Fourth Edition. By Frank W. Clarke. Bull. 695, U. S. Geological Survey, 1920. Pp. 832, index.

Bibliography of Petroleum and Allied Substances, 1917. By E. H. Burroughs. Bull. 180, Bureau of Mines, 1920. 170 pp., index.

Gypsum Deposits of the United States. By R. W. Stone and others. Bull. 697, U. S. Geological Survey, 1920. 326 pp., ill., maps, index.

Copper in 1918. By B. S. Butler. I:28, U. S. Geological Survey, 1920. Pp. 59. From Mineral Resources of the United States, 1918, Part I.

Peat in 1919. By K. W. Cottrell. II:4, U. S. Geological Survey, 1920. Pp. 6. From Mineral Resources of the United States, 1919, Part II.

Annual Report of the Board of Regents of the Smithsonian Institution, 1918. 612 pp., ill., index. Government Printing Office, Washington, D. C.

Petroleum in 1918. By E. Russell Lloyd. II:32, U. S. Geological Survey, 1920. Pp. 201. From Mineral Resources of the United States, 1918, Part II.

Coke-Oven Accidents in the United States During the Calendar Year 1919. By William W. Adams. Technical Paper 266, Bureau of Mines, 1920. 25 pp.

Stenches for Detecting Leakage of Blue Water Gas and Natural Gas. By S. H. Katz and V. C. Allison. Technical Paper 267, U. S. Bureau of Mines, 1920. 22 pp.

Stone in 1918. By G. F. Loughlin and A. T. Coons. II:34, U. S. Geological Survey, 1920. Pp. 125, map. From Mineral Resources of the United States, 1918, Part II.

Production of Explosives in the United States During the Calendar Year 1919. By William W. Adams. Technical Paper 259, Bureau of Mines, 1920. 31 pp., 2 fig.

Dividends From Mines, United States and Canada

UNITED STATES

Company and situation	Metal	Shares issued	Par value	Paid in 1920	Total	*Latest dividends	
						Date	Per share
Adams and situation					\$12,150,000	Sept. 30, 1920	\$0.50
Adams and situation					15,785,000	May 30, 1918	0.50
Adams and situation					2,850,000	Feb. 31, 1919	1.00
Adams and situation					47,855,598	Dec. 15, 1920	1.00
Adams and situation					72,290,389	Dec. 1, 1920	1.75
Adams and situation					5,003,300	May 1, 1920	1.50
Adams and situation					175,938,750	Nov. 1, 1920	1.00
Adams and situation					1,080,000	Nov. 20, 1920	0.05
Adams and situation					6,204,500	Dec. 14, 1918	0.50
Adams and situation					2,713,728	Aug. 31, 1919	0.18
Adams and situation					24,037,894	May 31, 1920	94
Adams and situation					1,080,500	Oct. 31, 1918	0.50
Adams and situation					440,000	July 31, 1920	0.05
Adams and situation					675,000	Sept. 30, 1919	0.25
Adams and situation					25,275,000	Dec. 31, 1920	0.25
Adams and situation					17,027,511	Sept. 1917	1.25
Adams and situation					300,000	Sept. 1919	0.50
Adams and situation					4,282,256	Jan. 5, 1921	0.01
Adams and situation					7,721,088	Jan. 30, 1920	0.50
Adams and situation					45,030,171	Dec. 30, 1920	1.00
Adams and situation					152,250,000	Dec. 30, 1920	6.00
Adams and situation					875,000	June 30, 1920	0.15
Adams and situation					300,000	Dec. 31, 1918	1.00
Adams and situation					300,000	Dec. 31, 1918	0.05
Adams and situation					300,000	Jan. 15, 1918	0.40
Adams and situation					25,250,201	Dec. 15, 1919	0.10
Adams and situation					1,871,517	Nov. 1, 1920	0.37 1/2
Adams and situation					353,092	Sept. 29, 1920	0.02 1/2
Adams and situation					29,991,709	Dec. 30, 1918	0.05
Adams and situation					11,450	Dec. 17, 1918	0.50
Adams and situation					408,000	Sept. 15, 1920	0.10
Adams and situation					26,998,315	June 10, 1920	0.10
Adams and situation					8,857,102	July 1, 1920	0.25
Adams and situation					3,132,500	Dec. 1, 1920	0.25
Adams and situation					6,808,000	Dec. 30, 1920	0.01
Adams and situation					900,000	April 25, 1920	0.90
Adams and situation					200,250	May 1917	0.25
Adams and situation					2,078,702	Dec. 23, 1920	0.50
Adams and situation					1,563,005	Dec. 31, 1919	0.12
Adams and situation					1,676,370	Oct. 1, 1920	0.02
Adams and situation					441,500	May 1915	0.04 1/2
Adams and situation					3,579,460	June 30, 1918	0.01 1/2
Adams and situation					300,000	Oct. 19, 1918	1.75
Adams and situation					698,084	Dec. 1920	0.15
Adams and situation					15,211,653	Feb. 25, 1919	0.00
Adams and situation					660,000	Aug. 1920	0.50
Adams and situation					2,490,000	Aug. 20, 1920	0.12
Adams and situation					5,033,917	Dec. 1920	0.05
Adams and situation					9,438,000	Dec. 31, 1919	0.03
Adams and situation					29,177,789	June 20, 1920	0.15
Adams and situation					1,825,450	Dec. 28, 1920	0.50
Adams and situation					8,505,000	Sept. 25, 1919	1.00
Adams and situation					41,202,124	Oct. 1920	0.02 1/2
Adams and situation					38,083,701	April 26, 1920	0.25
Adams and situation					3,275,000	Sept. 20, 1920	0.50
Adams and situation					1,031,892	Aug. 30, 1919	0.07
Adams and situation					2,025,000	Aug. 1, 1918	0.12 1/2
Adams and situation					2,650,000	Oct. 1, 1920	0.50
Adams and situation					53,502,344	Dec. 20, 1920	0.10
Adams and situation					5,574,120	June 30, 1920	0.07
Adams and situation					2,701,020	Jan. 20, 1921	0.50
Adams and situation					7,469,573	Jan. 6, 1919	1.00
Adams and situation					1,323,373	Aug. 15, 1917	0.50
Adams and situation					486,585	Nov. 15, 1920	1.00
Adams and situation					22,957,057	Nov. 1, 1920	0.25
Adams and situation					9,675,000	Sept. 30, 1920	0.02
Adams and situation					46,768,626	April 20, 1919	0.05
Adams and situation					110,627	May 21, 1919	0.25
Adams and situation					1,549,005	Aug. 25, 1920	0.25
Adams and situation					1,350,000	Jan. 1, 1919	4.00
Adams and situation					2,705,000	Nov. 1920	0.25
Adams and situation					11,200,000	Oct. 28, 1918	0.30
Adams and situation					14,657,000	Dec. 31, 1920	1.00
Adams and situation					5,100,000	Dec. 31, 1918	0.50
Adams and situation					14,405,260	Jan. 4, 1919	94
Adams and situation					14,157,500	Sept. 1, 1920	0.50
Adams and situation					1,129,036	June 30, 1920	2.50
Adams and situation					14,849,475	Oct. 1, 1920	124
Adams and situation					94,500,000	July 1919	0.01 1/2
Adams and situation					2700,240	Oct. 20, 1920	1.00
Adams and situation					11,692,080	Mch. 29, 1920	0.25
Adams and situation					27,002,500	Dec. 31, 1920	0.25
Adams and situation					25,412,621	Nov. 15, 1917	0.25
Adams and situation					1,425,000	Jan. 20, 1920	0.15
Adams and situation					7,012,500	Jan. 1, 1918	0.10
Adams and situation					15,198,560	April 1, 1919	0.50
Adams and situation					1,562,705	Dec. 20, 1920	0.03
Adams and situation					22,450,744	July 1916	0.03
Adams and situation					795,000	Dec. 25, 1919	0.03
Adams and situation					515,123		

*These figures include dividends payable on or before December 31, 1920.
Abbreviations: g. = gold, s. = silver, c. = copper, l. = lead, z. = zinc, n. = nickel, mn. = manganese.

Note: Companies not included in the above list are requested to submit details. Changes in capitalization and new dividends will be entered on receipt of the information. This table will be published quarterly. Corrections are invited.

Company and situation	Metal	Shares issued	Par value	Paid in 1920	Total	—Latest dividends—	
						Date	Per share
Tennessee Copper, Tennessee.....	copper and acid	391,498	no par value	.....	5,696,250	May 15, 1918.....	2.00
Tintic Standard, Utah.....	l.s.	1,174,500	1.00	469,880	1,420,862	Dec. 23, 1920.....	0.20
Tom Reed, Arizona.....	gold	909,555	1.00	163,720	2,919,671	Dec. 20, 1920.....	0.03
Tonopah Belmont Dev., Nevada...	s.g.	1,500,000	1.00	150,000	10,193,063	Jan. 1, 1921.....	0.05
Tonopah Extension, Nevada.....	s.g.	1,282,801	1.00	193,407	2,619,391	Oct. 1, 1920.....	0.05
Tonopah Mining, Nevada.....	s.g.	1,000,000	1.00	50,000	14,925,000	Oct. 21, 1920.....	0.05
United Eastern, Arizona.....	gold	1,363,000	1.00	981,360	3,134,900	Oct. 28, 1920.....	0.15
U. S. S. R. & M., U. S., Mexico....	l.z.c.s.g.	{ com. 351,115 pfd. 486,350	50.00	2,106,693	15,140,222	Oct. 15, 1920.....	1.50
United Verde Copper, Arizona....	copper	300,000	no par value	1,702,225	24,881,268	Oct. 15, 1920.....	0.87 1/2
United Verde Extension, Arizona..	copper	1,050,000	0.50	1,800,000	55,097,000	Dec. 10, 1920.....	1.50
Utah Apex, Utah.....	c.l.s.g.	528,200	5.00	2,100,000	11,150,000	Nov. 1920.....	0.50
Utah Con., Utah.....	c.l.s.g.	300,000	5.00	132,050	1,254,475	Nov. 11, 1920.....	0.25
Utah Copper, Utah.....	copper	1,624,490	10.00	.....	12,810,000	Mch. 23, 1919.....	0.25
Utah Metal, Utah.....	l.c.s.s.	691,588	1.00	9,746,940	111,509,662	Dec. 31, 1920.....	1.50
Vindicator Con., Colorado.....	gold	1,500,000	1.00	.....	895,734	Dec. 10, 1917.....	0.30
Wellington Mines, Colorado.....	l.z.	1,000,000	1.00	15,000	3,847,500	Jan. 24, 1920.....	0.01
West End, Nevada.....	s.g.	1,788,486	5.00	.....	1,950,000	Jan. 2, 1919.....	0.19
Wolverine, Michigan.....	copper	60,000	25.00	178,848	1,251,940	June 5, 1920.....	0.10
Yellow Pine, Nevada.....	z.l.	1,000,000	1.00	30,000	10,350,000	Jan. 2, 1920.....	0.50
Yukon Gold, Alaska, Cal., Nev....	gold	3,500,000	5.00	90,000	2,593,000	Sept. 30, 1920.....	0.03
				.....	9,858,110	June 1918.....	0.02 1/2

CANADA

Belmont Surf Inlet, British Columbia	g.c.	2,500,000	1.00	250,000	500,000	Jan. 1, 1920.....	0.02 1/2
Coniagas, Ontario.....	silver	800,000	5.00	1,100,000	10,740,000	Dec. 22, 1920.....	0.75
Con. M. & S., British Columbia...	l.c.z.s.g.	419,098	25.00	1,503,370	8,679,651	Oct. 1, 1920.....	0.62 1/2
Crown Reserve, British Columbia.	silver	2,000,000	1.00	.....	8,300,000	Dec. 30, 1916.....	0.05
Dome Mines, Ontario.....	gold	4,000,000	10.00	419,167	1,919,167	Oct. 1, 1920.....	0.25
Florence, British Columbia.....	l.s.z.	1,100,000	1.00	.....	35,300	April 20, 1919.....	0.01 1/2
Granby Con. M. S. & P., B. C.....	c.e.s.s.	150,000	100.00	.....	10,662,837	May 1, 1919.....	1.25
Hedley, British Columbia.....	gold	240,000	10.00	.....	2,495,520	June 30, 1919.....	0.10
Hollinger, Ontario.....	gold	4,920,000	5.00	2,214,000	12,480,000	Dec. 31, 1920.....	0.05
Howe Sound, B. C. and Mexico....	copper	1,984,150	1.00	396,830	1,091,281	Oct. 15, 1920.....	0.05
International Nickel, Ontario.....	n.c.	{ com. 1,673,384 pfd. 89,126	25.00 100.00	.....	53,113,676	Mch. 1, 1919.....	1.00
Kerr Lake, Ontario.....	silver	600,000	4.00	534,756	8,021,226	Nov. 1, 1920.....	1.50
Lake Shore, Ontario.....	gold	2,000,000	1.00	80,000	8,865,000*	Oct. 11, 1920.....	2.00
La Rose Mines, Ontario.....	silver	1,500,000	1.00	80,000	280,000	Oct. 1, 1920.....	0.02
McKinley-Darragh, Ontario.....	silver	2,247,692	1.00	.....	6,300,546	April 15, 1918.....	0.20
McIntyre, Ontario.....	gold	3,640,283	1.00	269,723	5,955,392	Dec. 31, 1920.....	0.03
Mining Corp., Ontario.....	silver	1,660,050	5.00	546,042	2,184,170	Dec. 31, 1920.....	0.05
Nipissing, Ontario.....	silver	1,200,000	5.00	622,519	5,499,868†	Sept. 15, 1920.....	0.12 1/2
Porcupine Crown, Ontario.....	silver	2,000,000	1.00	1,800,000	22,740,000	Dec. 1920.....	0.25
Rambler-Cariboo, British Columbia.	l.z.s.	1,750,000	1.00	.....	840,000	June 1, 1917.....	0.06
Standard, British Columbia.....	l.z.s.	2,000,000	1.00	.....	560,000	Feb. 15, 1919.....	0.01
Temiskaming, Ontario.....	silver	2,500,000	1.00	.....	2,700,000	Oct. 15, 1917.....	0.05
Tough-Oakes, Ontario.....	gold	531,500	5.00	100,000	2,159,156	Jan. 31, 1920.....	0.04
Trethewey, Ontario.....	silver	1,000,000	1.00	.....	398,625	Jan. 15, 1917.....	0.12 1/2
				.....	1,211,999	Jan. 2, 1919.....	0.05

*In addition there was a payment of \$600,000 made on July 3, 1919, to the Kerr Lake Mines, Ltd., as a return of capital to the stockholders of that company.

†In addition \$1,652,260 was paid by individual companies prior to the amalgamation in 1914.

Company Reports

CHIEF CONSOLIDATED MINING COMPANY

Report for the year ended December 31, 1920.

Property: Eureka, Utah.

Operating Officials: Cecil Fitch, general manager; J. Fred Johnson, superintendent.

Financial Statement: yield from production, \$2,242,708.-58; net profit on operation, less Eastern office expense, \$328,881.37.

Dividends: 1920, \$353,792.80; February 1, 1921, \$44.-201.60; to date, \$1,915,719.27.

Development: 23,801.9 ft., 2000 ft. less than 1919.

Production: 82,430 tons of ore of an average gross value of \$47.29 per ton.

TOMBOY GOLD MINES COMPANY, LTD.

Report for the year ended June 30, 1920.

Property: mines and mills at Telluride, Colorado.

Operating Officials: J. S. Peterson, general manager; W. K. Betty, metallurgical adviser.

Financial Statement: written off for property, plant, and machinery, with taxes paid and reserved, £37,996 17s. 7d. Deducting balance carried forward from last year, leaves a debit balance of £21,581 8s. 2d.

Development: very little done during the year. Ore-reserves, 888,244 tons.

Production: 146,066 tons ore was milled, producing bullion of the value of \$811,989.55.

The new plant commenced operations, as to one unit, for

five days in December 1919; and in January 1920 the full plant was put into commission. Unfortunately all the months in the latter half of the year, with the exception of March, have shown losses in working, in part owing to other causes, but principally to the difficulties of starting the new plant, and the adjustment of the treatment of the different ores in the mine.

BROKEN HILL PROPRIETARY COMPANY, LTD.

Report for the year ended May 30, 1920.

Property: Silver-zinc-lead mines at Broken Hill, iron mines at Iron Knob, South Australia, and steel works at Newcastle, New South Wales, Australia.

Operating Officials: G. D. Delprat, general manager; E. J. Horwood, works manager at Broken Hill; R. T. Slee, mine manager.

Financial Statement: The net profit for the year amounted to £517,663 3s. 2d., from steel-works operations.

Owing to the strike, which began on May 5, 1919, no work of a productive character has been carried on throughout the year.

McINTYRE PORCUPINE MINES, LTD.

Report for the year ended June 30, 1920.

Property: mines and mill at Schumacher, Ontario, Canada.

Operating Official: R. J. Ennis, general manager.

Financial Statement: An operating profit of \$1,051,404.-13, and a non-operating profit of \$228,828.24, were earned during the year.

Dividends: \$546,042.45.

Development: 4808.7 ft., with 4538 ft. of diamond-drill-

ing, estimated ore-reserves amounted to 502,682 tons, with a value of \$5,595,500.80.

Production: 188,835 tons of ore was treated. Bullion containing 39,461.39 oz. of gold and 21,140.3 oz. silver was recovered. The mill operated continuously and satisfactorily. The percentage yield dropped slightly during the latter period of the year, due to the premature precipitating action of graphitic schist in the ore broken from development from the 1250 and 1375-ft. levels. From experiments and large-scale tests it has been decided that this class of ore can most economically be treated by eliminating the graphitic material by flotation before treatment by cyanide. Plans are made and a flotation addition to the mill will shortly be in operation.

DAVIS-DALY COPPER COMPANY

Report for the year ended June 30, 1920.

Property: mines at Butte, Montana.

Operating Official: J. L. Bruce, general manager.

Financial Statement: receipts, \$1,944,600.31; disbursements, \$1,652,421.61; net operating profit, \$292,178.70.

Development: 10,149 ft.; ore-reserves amounted to 257,377 tons.

Production: 122,379 tons of ore was shipped containing 319,334 oz. gold, 902,978.717 oz. silver, and 13,564,064 lb. copper.

YUKON GOLD COMPANY

Special report, dated December 10, 1920.

Properties: California and Idaho; Jarbidge, Nevada; Yukon Territory; Federated Malay States.

Operating Officials: O. B. Perry, general manager; C. H. Munro and J. B. Newsom, examining engineers in Malaya.

Financial Statement: Assets (including bullion in transit valued at \$302,559.71), \$7,891,694.52; liabilities, \$5,061,972.73; balance of assets over liabilities, including estimated valuation of properties, \$2,829,721.79.

Development: 2182 acres of dredge ground in Federated Malay States, estimated to yield 75,115,000 lb. tin, after deduction of dredging and smelting losses; 5000 tons of ore assaying 200 oz. silver and 68% lead in Yukon Territory.

Production: At Jarbidge, Nevada, 104,469 tons has been milled to date, yielding bullion valued at \$1,181,900, with net profit of \$555,229. Ore blocked out is estimated to yield a profit of \$500,000.

MOUNT LVELL MINING & RAILWAY COMPANY, LTD.

Report for the year ended September 30, 1920.

Property: Mine, mill, and smelter at Mount Lyell, Tasmania.

Operating Officials: Robert C. Stiebt, general manager; Basil Sawyer, local superintendent; R. P. Roberts, chief metallurgist; R. M. Murray, mine superintendent; G. F. Jakins, assistant mine superintendent; C. W. Wright mechanical engineer.

Financial Statement: The working account shows a profit of £152,162 7s.3d. The net profit amounts to £76,007 11s.8d., after deducting amounts for prospecting and development, and depreciation of mine plant. The net profit for the previous year amounted to £130,232 18s.1d.

Development: No additions to the ore-reserves of the Mount Lyell mine were made during the year. Additional diamond-drilling at the North Mount Lyell mine, however, has resulted in an addition of 126,873 tons to the ore-reserves. The total ore-reserves on September 30 amounted to 1,802,509 tons at the Mount Lyell mine, with an average assay of 0.50% copper, 1.5 oz. silver, and 0.04 oz. gold; and 1,013,518 tons at the North Mount Lyell mine, with an average assay of 6% copper, 1.33 oz. silver, and 0.005 oz. gold per ton.

Production: The flotation plant treated 34,239 tons of ore, averaging 3.32% copper, producing 9251 tons of concentrate. The smelter treated 169,649 tons of ore and concentrate, producing 4536 tons of copper, 168,109 oz. silver, and 5164 oz. gold, as compared with a production of 5314 tons of copper, 266,864 oz. silver, and 5538 oz. gold, during the previous year.

The company has commenced operation in connection with additional subsidiary industries, including the production of caustic soda and hydrochloric acid by electrolysis.

MOUNT MORGAN GOLD MINING COMPANY, LTD.

Report for the half-year ended November 28, 1920.

Property: Mines, concentrators, and smelters at Mount Morgan, Queensland, Australia.

Operating Officials: A. A. Lloyd, general manager; J. Horsburg, assistant general manager.

Financial Statement: Total revenue for half-year amounted to £656,977 7s.6d.; expenditure charged to profit and loss, including development and depreciation, £550,703 9s.0d.; surplus, £106,273 18s.6d.

Dividends: No dividends were paid during the period because of the lock-up of funds represented by the amount of metal in process, the refining of which was delayed by strikes.

Development: The ore-reserves amounted to 3,318,134 tons, containing 2.58% copper and 6.04 dwt. gold, as compared with 3,437,687 tons, containing 2.59% copper and 6.11 dwt. gold, on May 30, 1920.

Production: 106,895 tons of ore treated in the concentration section for the production of 39,436 tons of concentrate. The smelting section treated 98,466 tons of concentrate and ore, and produced 3451 tons of copper and 52,686 oz. gold.

NORTH BROKEN HILL, LTD.

Report for the year ended June 30, 1920.

Property: Mines and mill at Broken Hill, New South Wales, Australia.

Operating Official: G. Weil, general manager.

Financial Statement: Assets show a surplus over liabilities of £469,777 2s.8d.

Dividends: No profit was made during the period, the mine having been closed since May 8, 1919, so far as productive operations are concerned.

Development: On account of labor troubles, no development work has been carried out. The ore-reserves remain at 2,600,000 tons.

The miners' union presented a new 'General Log of Wages and Conditions of Employment', the terms of which are as follows:

Wages: £1 per shift for all men and boys alike, whether working on the surface or underground.

Hours: Six-hour shifts per day on surface and underground, worked only on five days per week.

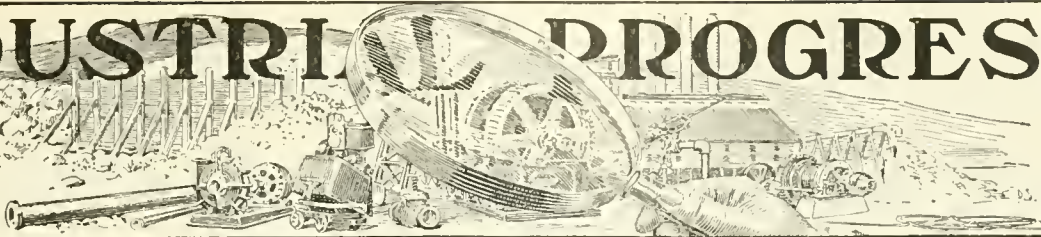
Night Shift: Abolition of night shift on surface and underground.

Contract System: Abolition of the contract system on surface and underground.

Compensation: Compensation on the basis of full pay for time lost for all complaints and diseases that may be attributed to the unhealthy nature of the work in the industry.

The miners' union refused to consider arbitration, neither would it act on an award made by the State Industrial Court. The company has taken an interest in a British concern promoted for the purpose of manufacturing white lead. Works are under construction at Cabarita, on Sydney Harbor, that will have a capacity of 4000 tons per annum.

INDUSTRIAL PROGRESS



INFORMATION FURNISHED BY MANUFACTURERS

BELT-CONVEYORS ON THE GOLD MINES OF THE WITWATERSRAND

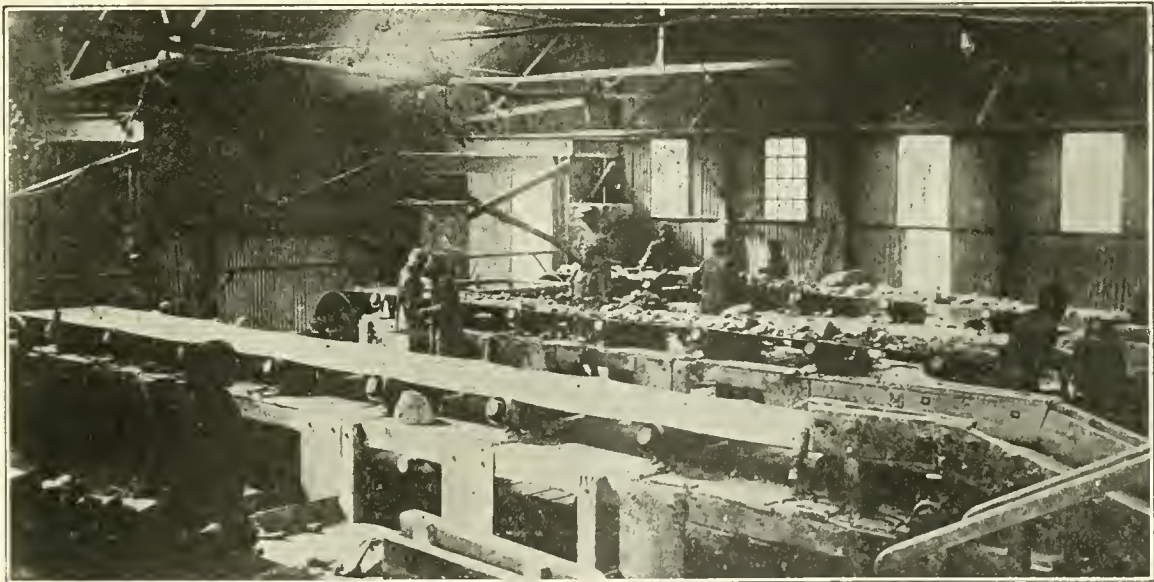
By H. D. Gumbley

In 1886 payable conglomerate ore was discovered on the 'farm' Langlaagte, two or three miles to the west of Johannesburg of today.

The 'reef', extending due east and west for 60 miles from Springs to Randfontein, consists at present of about 135,000 claims, each claim equalling 64,025 sq. ft. or 1.47 acres. Operating these claims are approximately 45 producing mines capitalized at \$750,000,000. These 45 mines operate 7972 stamps, employ approximately 23,000 whites and

crushing-station, and here is found the most severe conditions under which belt-conveyors have to operate. The ore is tipped from the trucks into a bin from which it is conveyed to the crushing-station on belts usually 30 or 36 in. wide, 7 or 8-ply, with $\frac{1}{4}$ or $\frac{3}{8}$ -in. rubber face. These belts travel about 170 ft. per minute.

The size of the rock falling on the conveyor-belt varies from fine gravel to pieces weighing several hundred pounds, and in many instances is sharp and jagged. On the property where this photograph was taken there are four of these belts, each 220 ft. long. No. 1, 2, and 3 drives are equipped with 'Indestructible' conveyor-belts, 30 in. wide, 7-ply, with $\frac{1}{4}$ -in. rubber conveying-face and $\frac{1}{2}$ in. underside.



Sorting-Belt in Gold-Mill on the Witwatersrand

200,000 natives, and mill upward of 2,000,000 tons of ore per month, yielding somewhere in the neighborhood of 700,000 oz. of fine gold which is worth approximately \$18,000,000.

The scope offered by this industry for the sale of mechanical rubber goods is large. Transmission and conveyor belting together forming one of the largest items of mine purchases within the scope of the United States Rubber Co.'s activity. The total value of belting purchased during 1919, according to official statistics, was \$935,000.

I estimate that there are not less than 800 belt-conveyors in constant use on the reef, ranging from belts 18 to 40 in. wide and 100 to 1200 ft. long. These belts handle gold-bearing ore in different stages of its 'refinement' and the conditions under which they have to operate are probably as severe as is met with in any part of the world. The conditions are all the more abnormal, due to the fact that most of the conveyors run under the minimum of supervision. The ratio of cheap colored labor to white skilled being in the neighborhood of about 9 to 1.

The ore is brought from the shaft head to a sorting and

The 'Indestructible' belt on No. 1 drive conveyed 160,000 tons of rock during a life of 15 months.

From the feed-belt the rock passes over grizzly-bars, set at an angle of from 38° to 45°, onto the sorting-belts shown in the accompanying illustration.

'Sorting' means separating and rejecting rock hauled to the surface containing little or no gold. Waste is usually quartzite and is distinguishable from ore, more easily when both have been slightly washed with water to remove any grit that might render the difference less marked. The ore is a conglomerate of quartz pebbles cemented together by a matrix having a dark bluish appearance when freshly mined.

The sorting-belts are usually 30 or 36 in. wide, 7 ply, with $\frac{1}{4}$ or $\frac{3}{8}$ -in. face, and travel at a speed of 30 to 40 ft. per minute. A slow belt-speed is necessary to allow time for picking out the waste rock by hand.

The waste removed is placed on another belt for conveyance to the dump. The life of a sorting-belt varies considerably and depends a great deal on the method of loading. On the particular mine where the photograph was taken, the grizzlies over which the rock passes from the

feed-belts to the sorting-belts are set at an angle of about 40°, and consequently the heavy rock comes down fairly fast and frequently a sharp edge of the rock is driven right through the belt. When this happens the hole which is usually not more than 3 to 4 in. long is repaired with Bristol belt fasteners.

The writer saw a new 'Indestructible' belt, which had only been on the drive a few days, with no less than three holes through the belt, all caused by excessively heavy rocks coming onto the belt at great velocity.

The ore is delivered by the sorting-belt to the breakers, which are usually of the gyratory or swinging-jaw type. Here the ore is reduced to about 3-in. cube and conveyed to the stamp-mill bin by belt-conveyor.

This belt is 542 ft. long and travels at a speed of 350 ft. per minute at an angle of 18°. Its life is in the neighborhood of 2½ years and it handles in that time roughly one million tons of ore.

The ore is finally delivered from the main belt onto a conveyor-belt called a 'shuttle' belt, running at right angles to the main belt. This belt is on a traveling cradle that runs on rails and moves backward and forward over the stamp-mill bins, discharging into the bins as required.

A SCORE-BOARD AS AN ACCIDENT PREVENTIVE

It has been eight years since the Dodge Manufacturing Co., of Mishawaka, Indiana, first started its accident score-board. During this period thousands of firms all over the United States have asked for the method of operation.

In the first place, when the sign-board was erected and planned, there was no thought of the pioneering that the Dodge Manufacturing Co. was doing in welfare work. The sole idea was to develop some means of cutting down preventable accidents in every department in the plant. W. L. Chandler, supervisor of insurance, decided the best plan to do this work would probably be to make use of a competitive spirit in workmen and foremen. Today, after eight years of operation, the score-board is as much a pride

to the worker personnel as is a record-breaking pulley or transmission equipment. One represents an achievement in human conservation and the other marks a mile-stone in mechanical progress—both of which are vitally essential to the success of a large organization.

The size of the board erected just inside the main gate of No. 1 plant was 17 by 24 ft., which gave plenty of room for large lettering. The mechanism for scoring points is as simple and fair as possible. The starting point is 1000, both for year and month; each division is penalized according to its accidents; each day's absence bears a percentage charge in proportion to the total number of 'men-days' per month per division.

The departments were divided into 26 divisions, according to the various degrees of natural hazard and variation in numbers of men employed. The degree of hazard is disregarded. The business covers the same general subject throughout the plant; the differentiation being considered as equalized in the choice or selection of men with reference to their ability and fitness for their respective classes of work.

The variation in the sizes and groups of workers was met by establishing a differential charge per man per day for time off, which is computed by reducing each division to men-days for each month, and using a multiplier of 10 to raise the figures to a more workable and understandable basis.

This system of scoring was finally arrived at after considerable experimental work and the present system seems to be fair in every respect and there has been no occasion to change it during the past few years, in spite of the fact that during this time almost every known condition has cropped up.

In the fourth column of this score-board will be noticed the figures which represent deductions for absence in that division.

At the end of each year the employees of the divisions scoring 1000 receive two days extra pay, or such part of that amount as their time and employment bears to a full year. If none score 1000, then the highest ranking division receives the two days pay. General foremen of any division under them earning these premiums.

The original plan was to distribute \$25 in cash each month to all foremen of divisions winning perfect scores, but due to the relative importance and the efforts of the foremen with a widely varying number of men this arrangement was changed so that one-half of each prize is paid on a flat basis and one-half distributed according to the number of men overseen; thus a foreman in charge of 50 men will get a proportionately larger premium than the one in charge of 10 men.

It will be noted that the cash prize is small, and by some it may be even considered as trivial, but it was the intention not to make the men strive only to secure the cash prize as much as to awaken in them a healthy competitive spirit.

Every member of each division is keenly alive to the fact that responsibility for keeping his division with a perfect score rests squarely on him, consequently he gauges his work and actions to conform with all the precepts of safety first. This interest is stimulated and fostered by making up the yearly basis out of the monthly averages. The great thought is then concentrated on the yearly contest, and the discouragement of any unfavorable monthly showing is avoided because any other division may have a penalty sufficient in some months to equalize these unfavorable periodical conditions.

HELP US PREVENT ACCIDENTS.

ACCIDENT PREVENTION SCORE-BOARD DODGE MANUFACTURING COMPANY.

Number Dept.	Name Department	Name Foreman	Deduction for Absence	Percentage Month	Rank For Month
FOUNDRIES					
10	CEPOULG YARDS	L KING	10	1000	1
17	CORE ROOM	G SCHNAU	10	1000	1
12	SOUTH	W WIDDLTON	7.5	1000	1
15	MANGER	G FLONG	1A	83.3	5
14	PULLEY	J BICKEL	16	1000	1
19	PATTERN	E GARTNER	38	1000	1
16	CHIPPING	J STUFF	6	77.6	3
MACHINE SHOP					
5	BEARING	J MILLER	15.5	1000	1
3	SHEAVE	R PRIEM	20	1000	1
3A	MACHINE	J ROUGH	28	1000	1
3B	ERECTING	J CONICK	19	1000	1
4	SPRINTING	W MOUTS	32	1000	1
6	CLUTCH	T KERYON	10	1000	1
2	LOCK PULLEY	G FRIEDMAN	10	1000	1
20	TOOL	G PETERSON	28	1000	1
WOOD SHOP					
1-A	SECRET	F VOST	115	1000	1
1-B	ARM	J PHILION	32	76.6	4
1-C	ASSEMBLING	C MARSH	7.7	76.5	2
1-D	FINISHING	C DEGRUOTE	28	1000	1
OTHER DEPARTMENTS					
7	STEEL SHOP	G HUNT	13.5	1000	1
27	INSPECTION	G MINTAL	52	1000	1
25	SHIPPING	G SHOE	87	1000	1
21	TAPE & SAW MILL	E DUS	11	1000	1
23	POWER	W TURNER	39	1000	1
22	M LING GHT	S BRUNYER	26	1000	1
9	METAL PATTERN	O FORD	104	1000	1

FOREMEN MONTHLY COMPETITION

All Departments
Having a Score of 1000
or the Highest Three
Scores will Receive
Special Prizes as per
Monthly Prize List.

PRIZE LIST FOR MONTH OF October

\$25.00
Equally divided
among the
Foremen having
a perfect score

ANNUAL COMPETITION

GENERAL

All Departments Scoring
1000 For the Year or the
One holding Rank one
in Yearly Percentage will
Receive Two Days Pay
Extra
Second Highest will Receive
One Days Pay Extra.

HEAD FOREMAN
WILL PARTICIPATE IN
FIRST PRIZE IF WON
BY A DIVISION IN HIS
DEPARTMENT.



T. A. RICKARD, Editor

ATENTION must be directed to a serious typographic error, appearing in our issue of February 12, in connection with the Yukon Gold Company's Malayan enterprise, in which we are made to say that the gravel averages 83 pounds of tinstone per cubic yard. It should be 0.83 pound.

OUR supply of scribbling-paper will be reduced in consequence of the vote of Congress refusing an appropriation for the continuation of the work of the Council of National Defense for the fiscal year 1922. This involves the discontinuance of the Daily Information Digest, which furnished us four or five pages of excellent paper daily, because one side was unspoiled.

PAPER-PULP is now being made in Alaska. We have received a letter written on a sample of the first pulp produced by the mill of the Alaska Pulp & Paper Company, of San Francisco. This enterprise is making use of the water-power developed on the Speel river by Mr. E. P. Kennedy and other engineers identified with the Alaskan mining industry. We hope they may be successful and that in due course the book-paper we use may come from Alaska.

NOW that the suffrage has been given to women, it is not surprising that the proverbial 'better half' is finding her way into new avenues of usefulness. For example, a lady has been elected to the board of directors of an important mining undertaking, the Champion Reef Gold Mining Company of India, which boasts an annual output of \$1,500,000 and workings 5000 feet deep. The lady in question is Mrs. Tennant, the wife of Mr. Harold J. Tennant, who is the brother of the late Lord Glenconner, the third son of Sir Charles Tennant, who, together with the engineering firm of John Taylor & Sons, was largely instrumental in finding the money that started the profitable exploitation of the Kolar gold-field, which includes the Champion Reef, Mysore, Nundydroog, and Ooregum mines, constituting the present gold-mining industry of India. Evidently the wife was preferred to the husband as a director; we are told by the 'Financial Times' that during the War "she herself filled with distinction the post of Government Superintending Inspector of Factories . . . and was one of the first of her sex to be made a Justice of the Peace". Apparently it is a tradition in the history of the Champion

Reef company that the Tennant family must be personally represented on the directorate. This Mrs. Tennant is a cousin of the irrepressible 'Margot', who as Mrs. Asquith, has added to the gaiety of the nations, but it may be inferred confidently that the two ladies are of different mental bias and that the new director of the Champion Reef is the more businesslike of the two, and therefore better fitted to be co-opted as a trustee for the shareholders in an important industrial enterprise.

FROM accounts that have reached us we conclude that the annual meeting of the Institute was a most successful affair. The total attendance was about 800, and the banquet was graced by 689. Not many members came from west of the Mississippi, for the simple reason that the discomfort of travel and the cost of it in these days restrain most people from making the transcontinental journey except when absolutely necessary. The program of entertainment included many attractive features; and as for the smoker! that was a marvel of delightful surprises, thanks to Mr. Mathewson's talent for creating fun. Mr. Hoover stepped down and Mr. Ludlow succeeded him as president. Both made excellent speeches at the banquet, one emphasizing the principle of the 'open shop' and the other the purpose of the Federated Engineering Societies. Reference was made to the San Francisco section and explanations were offered for the deficit in the finances of the Institute. We note, with keen pleasure, that Dr. Henry S. Drinker has been made an honorary member.

IT is a pathetic commentary on modern conditions that the preceptors of the rising generation are generally so poorly paid that they can make little or no effort to collect a fund to offset the physical and mental depreciation of old age, often incurred prematurely by their own unselfish efforts, or to provide adequately for those they leave behind them. We learn with regret that the remuneration received by the late J. J. Beringer, the principal of the Cornish School of Mines, at Camborne, for nearly thirty years, was so little that he was unable to make provision for his widow. His treatise on assaying, like most technical books, was doubtless unremunerative to the author, though of assessable value to the industry. It places Beringer on an international footing with mining engineers. A memorial fund has been opened for

subscription, the interest of which will be given to the widow, the principal being used afterward for scholarships and prizes. Some of our readers will welcome an opportunity of adding to this. We shall be glad to forward any contributions received; or they may be sent direct to Mr. T. Knowles, Mining School, Camborne, England.

OUR friend Mr. F. H. Mason writes on the subject of capitalization, not of companies but of letters; he urges the need for uniformity of style in this and in other literary matters. Every technical periodical has its style, as he says; so we venture to mention one or two of our own rules. In the first place the only President is the Chief Executive of the United States; the heads of companies and institutions are presidents. In the United States, kings are not capitalized, they are liquidated. State and Province are equally honored; so is the Federal power and that of the Dominion. 'Minister of Mines' is a title; so is 'Professor of Mining'; whereas "superintendent of the Bonanza mine" is descriptive; so is "secretary of the Canadian Institute"; 'Provincial' means belonging to the Province, whereas 'provincial' is the antonym of 'metropolitan'. The Government means the administration of the country; a government is of less consequence. A government or a company is a unit, and therefore calls for a singular verb. So does the United States when regarded as a nation. Nothing is more singular than the unnecessary use of the plural.

FROM the latest information available it is evident that claimants under the War Minerals Relief Act have been greatly disappointed. The report sent by the Secretary of the Interior to the Senate shows a total of 1207 claims aggregating \$18,131,493, whereas only \$2,457,259 has been awarded. The total amount involved in the claims on which awards were made was \$7,871,315; the amount involved in the claims still pending is \$3,106,697, and the amount of claims withdrawn is \$646,577. Of the claims disallowed, \$6,506,903 is covered by absence of proof of Government request to claimant to produce War minerals. Of the 1200 claimants, 800 have been denied any relief whatsoever. The result is discreditable to the Administration and a slur on the honor of the United States government. Money was spent lavishly, even recklessly, for munitions and other war materials, and there is no excuse for adopting a meticulously legalistic attitude toward the men who did notable service in providing the minerals from which were produced the metals required for warfare. The denial of \$6,500,000 of claims because the claimants could not furnish proof of direct request from the Government is grossly unfair to the smaller producers, who, of course, obtained their information on the subject by indirect means, as through the columns of the 'Mining and Scientific Press' and other papers, technical and untechnical. The producers of war minerals have not been treated in the spirit with which they went to work, at a time of crisis, in order to assist the national cause; their motives have been subjected to a catechism that was as unjust as it was un-

philosophical, for no act is the product of a single motive. If a man comes to your help when you are asking for it, you do not examine his motives too closely after he has given the assistance for which you ask; you do not tell him that he did it partly to gratify himself, or partly to win the good repute of his neighbors; you thank him and pay him back at the first opportunity. The mental attitude of the Commission reflects no credit on the Government; in trying to be smart, it has succeeded in being petty.

PRIOR to 1898 a first-class brick-mason working under average conditions received 42c. per hour for his work and laid 1500 bricks per day. Since then wages have increased gradually to \$1 per hour, but the daily performance of a mason is measured by the laying of from 400 to 500 bricks. It is true the eight-hour working-day was not in vogue in 1898, but it is also true that most masons today could lay from 1000 to 1200 without excessive exertion. The reason why they do not may be found in the tacit but none the less rigidly observed regulations made by the Brick Masons and Plasterers International Union, whereby a maximum allowable daily stint is established. Since 1898 this maximum has been arbitrarily reduced by successive steps; in 1906 it was 1000; in 1915, 700; in 1919, 600. Brick-masons, of course, are not peculiar in this regard; the same condition prevails in nearly all of the labor-unions, and it is this policy that is driving employers toward the 'open shop'. The payment of wages on a scientific basis recognizes two principles, namely, that the minimum wage should be adjusted to meet the cost of decent living, and that the earnings of different individuals should vary with the competence and industry of the worker, that is, with the quantity and quality of his output. The labor-unions ignore the second principle and advance the theory that the work accomplished by the least skilful and the least energetic shall be the measure of the work done by all. That labor-unions have a place in our economic system, and that they have been instrumental in correcting injustice on the part of employers that otherwise would never have been corrected must be admitted; but the principle of restriction of individual output is unsound, and if maintained it will result in harm to the working-man himself. We believe that an industrial system will ultimately be developed under which the interests of the employer and the employee will agree rather than conflict; when even the least competent can earn an adequate living if he is conscientiously industrious; when each individual will find an incentive to do his best work at all times; and when the employer will find it profitable to pay high wages. Such a program is easy to plan and difficult to accomplish; but therein lies the hope of future industrial prosperity.

ONE Edmond Temple, a gentleman who, had he been alive today, would no doubt have called himself a mining engineer, published, in 1830, a book on travel and mining enterprise in South America. Speaking of the great mines of Potosi, he says: "It has been asserted by

some that the *cerro* of Potosi is of volcanic origin; but this I have heard contradicted in the most positive manner. For myself, I presume not to offer any opinion on the subject; geology is a science which till lately has been strangely neglected, even by those who have received the most liberal education. I may observe, however, that, having visited Vesuvius and Etna, I saw nothing in or about the composition of the mountain of Potosi that resembled or reminded me of either of these two volcanoes. Our chief miner in vain endeavored to discover at or near the mountain anything like pumice-stone, which would have been a convincing proof of volcanic origin, had any such been found." We are not surprised to read, in another part of the book, that the party did all it could in preparation for a tedious time, even to the provision of a quantity "of gingerbread nuts and peppermint drops, to comfort us", as the chronicler quaintly remarks, "on our journey across the continent of South America". The expedition, as one might conjecture, was a failure; and Temple reprints the resignation sent to his board of directors, the concluding portion of which reads as follows: "For my own part, to whatever quarter the storm of life may blow, it will bear me a willing guest; but as it is not to my taste to eat the bread of idleness, more particularly at the expense of others, I have no wish to while away the three years of my contract by concealing from your Board that there is no longer any occasion here for the services of your obedient, humble servant, Edmond Temple." We commend the phraseology to those of gentle nature who, like Temple, are unqualified and unsuited to the actualities of mining work, and who find themselves at variance with their surroundings.

RECOGNITION of a chronic malady is frequently the first step toward its relief. When a man confesses that he is losing his normal vigor, and that he misses some of the resilience of former years, he is likely to see the prudence of paying some attention to his diet; he is impressed with the benefits to be derived from regular hours of sleep; and in other ways he may take care of himself, thereby postponing impending decadence. Something akin to this, we suspect, is the purpose of a bill recently introduced in the Colorado Legislature by representatives from all the mining counties of the State. As Mr. Ezra D. Dickerman of Leadville rather dolefully but frankly remarks, "The mining industry of Colorado needs help"; the State that was once second to none in the value of its mineral production, and in which fifty big mines flourished at one time, has lost its health so far as mining is concerned. Apparently the case has been diagnosed, however, and a prescription prepared, for, to quote Mr. Dickerman again, "If this bill passes the General Assembly it will pave the way to the rehabilitation of the industry in this State". The measure, which is said to have the support of virtually every mining man in Colorado, provides for the appointment by the Governor of a State Board of Mining to consist of nine members all actively engaged in the mining industry, and all of whom are to serve without pay. A tax of one

mill on the value of all metal mines in the State is to supply \$30,000 per year to finance the work of the board, which is to devote itself to investigations concerning prospecting, mining, marketing ores, freight-rates, and smelter charges, the point of view being economic rather than technical. On the face of it, the bill is unique; it seeks neither to create well-paid sinecures for the members of the board nor to augment the State budget by an appropriation from the general funds. The object of having the board appointed by the Governor seems to be to give it standing and to enable it to subpoena witnesses to testify at its investigations. In other respects the result would be the same if the mining companies organized a committee of their own. We refuse to believe that the mineral resources of Colorado are even within sight of exhaustion and we are glad to record any well-considered proposal for giving fresh life to a mining industry that we feel assured is not dying, but in need of adequate stimulus.

Taxation of Mines

This is a problem always fruitful of contention, for the reason that mining property is more difficult than any other to appraise accurately. The result of this difficulty has been the establishment of a variety of methods for determining the tax to be paid by the owner of a mine, together with constant agitation for changes and revisions. A number of western States use the net profit of a mining company as the basis for taxation, by applying the regular levy to a multiple of the profits. The factor used is generally two or three. In Canada, the Provincial Legislature of Ontario has fixed a special rate applicable to the net profits of mines only. A bill is now before the House in session at Toronto proposing to increase the existing rates from 3% to 4% "on the excess of annual profits . . . above \$10,000, and up to \$1,000,000", and from 5% to 7% on the excess over \$1,000,000. For some reason, an exception is made of nickel and nickel-copper mines, the minimum for such properties being 5, instead of 4%, as fixed for producers of gold and silver. This proposed legislation was probably inspired by the immense prosperity experienced by the mines of Cobalt prior to the decline of the silver market in the latter half of 1920. The present bill would doubtless have found more support, because of its sentimental appeal, had the slump not come just when it did. Mr. A. F. Bingham, manager of the Hollinger mine, in a recent address pointed out that the three large mines of the Porcupine district alone paid \$2,500,000 in wages last year, in addition to an approximately equal amount for supplies; he urged that no unreasonable burden be put on an industry of such importance to the welfare of the Province. We can imagine the attitude of the average legislator, who, as he pictures the glittering bars of gold and silver bullion fresh from the mills, concludes that here is an appropriate place to gather the money wherewith to run the government. He probably would not believe it if he were told that, by and large, as much money goes into wages for those who dig in search of ore

as is obtained from the sale of all the metal produced. The prosperity of Northern Ontario depends upon its mines, and any legislative enactment that tends to discourage investment in mining property will retard the development of the industry. The lawmakers should be sure that they do not strangle the goose that lays the eggs of gold—and silver. A revision of the method of taxing the copper-mining companies in the Lake Superior region of Michigan is also under consideration. The present plan is to estimate the value of the property by averaging the market-value of the stock-shares on the 52 Mondays of the year. The regular tax levy is then applied to the valuation thus determined. The proposed method is to appraise the surface improvements at their actual value, and to base further valuation on the quantity and grade of ore mined during the tax year. Just what the details are, we have not learned, but it is said that many of the smaller companies favor the new plan. They are averse to paying taxes for periods when production has been practically nothing, and when the balance-sheet shows an operating loss. And yet the man who owns a farm doesn't think of escaping taxation on the fair value of his land just because he has a light crop or a poor market for his product. However, there are inherent peculiarities about a mining property that make the problem of taxation unique. The prescription of a standard form of financial statement, together with a uniform system of accounting, and the adoption of a tax based on profits is one solution of the problem.

The Education of Engineers

Our 'Discussion' department is enriched this week by a thoughtful and suggestive letter from Mr. Walter S. Weeks, Associate Professor of Mining in the University of California. Professor Weeks writes as a Harvard graduate who has lived in the West, and we find ourselves, naturally, in accord with most of his views. We can imagine how some of his sallies would have tickled Huxley, for it is about fifty years since scientific men succeeded first in convincing an unsympathetic world that culture could come from the study of biology and geology as well as from the learning of Greek and Latin. The echoes of that early conflict of opinions have died away down the aisles of time and the post-Victorian age has accepted the idea that culture resides not only in the knowledge of the classics but in all that concerns humanity and the human effort toward enlightenment. "Education is a continuous process", says Professor Weeks. Yes, indeed. It continues through life, and when it ceases a man is moribund intellectually. John Richard Green, the historian, asked that his epitaph might be, "He died learning". The motto of the school to which the present writer went was, "We learn not for school, but for life". The discontinuity in the education of our mining engineers is its saddest feature. They go to school and college; they come in contact with the best minds, in men and books; they rub shoulders with a liberal culture; and then they go forth to make a career, during which, in many instances, alas, they become too

absorbed to continue the process of education; and by the time their active days are over they are little better than machines ready to be scrapped. The instruction that the average youth undergoes fails in becoming an education; too often it is only a training for earning his daily bread. It ought to be "a power for accomplishment", as the Professor says. To accomplish what? Surely more than making money, for a hod-carrier can do that. After all, what is the purpose of educational effort? To make a man effective in his day and generation, to turn an engineering student into an efficient engineer. But that is not all; we must consider him as a citizen in the community; he ought, by reason of his educational preparation, to be a better husband and a better father, a better citizen; he ought to be happier for his mental training and he ought to contribute in larger measure to the happiness of his fellow-men. We agree that the so-called broad education should not involve the sacrifice of precise knowledge on the matters that more particularly concern the engineer as a technician, for a man is not likely to be happy or to make others happy if he fail to do his own work well. Indeed, the discussion can be brought down to the question of the amount of general culture that can be absorbed without trespassing upon the time needed to learn how to obtain one's bread and butter, plus a reasonable addition of condiments. "Art is long and time is fleeting", and the budding engineer cannot acquire all the learning or gain all the accomplishments that a fairy godmother might wish for him. The European goes to one extreme, the American to the other. In the old world they strive for culture at the expense of practical training; in the new world, our young men look to the main chance and forego those things that are more excellent. It is a tremendous problem. We agree with Professor Weeks that it is absurd to suppose that general mental culture can be obtained in a mining college, or even in a university; the seeds of it must be planted earlier, in the home and in the preparatory school; the university will encourage them to take root and grow to fruition. A liberal education cannot be planted on sterile soil. Some questions are answered best by stating them in terms the truth of which is incontrovertible. What is a "liberal education"? Let Huxley answer once and for all:

"That man, I think, has had a liberal education who has been so trained in youth that his body is the ready servant of his will, and does with ease and pleasure all the work that, as a mechanism, it is capable of; whose intellect is a clear cold-logic engine, with all its parts of equal strength, and in smooth working order; ready, like a steam-engine, to be turned to any kind of work, to spin the gossamers as well as to forge the anchors of the mind; whose mind is stored with a knowledge of the great and fundamental truths of Nature and of the laws of her operations; one who, no stunted ascetic, is full of life and fire, but whose passions are trained to come to heel by a vigorous will, the servant of a tender conscience; who has learned to love all beauty, whether of Nature or of art, to hate all vileness, and to respect others as himself."

A Nice Point

A question of professional morality has been raised in connection with the employment by the Dupont company, at high salaries, of two expert dye chemists, recently arrived from Germany. These gentlemen were released from Ellis Island on January 5, after an investigation had been made by the immigration authorities, following the receipt of a protest from Germany against their detention. It is reported that warrants were issued for their apprehension in the fatherland, and these they succeeded in evading. This official interference is interpreted as a move to prevent the development of a dye industry in this country that would interfere with the German export trade. Germany is chagrined at the disloyalty of her scientists. The Dupont company, according to the press, has issued a statement excusing its action on the grounds that the Germans were needed "to interpret and help put into practical operation the processes and formulae covered by the patents seized when this country went to war with Germany. In many cases the records filed with the Patent Office are incomplete, giving misleading information, and are otherwise so craftily devised that only a German chemist can put them into practical use. The American chemist has already solved so many of the problems involved in the manufacture of dyes that about all that is needed from Germany is the worker experienced in the manufacturing end of the business." This explanation is somewhat inconsistent with the fact that Dr. Otto Runger and Dr. Joseph Flachländer are evidently of the expert class. The salary to be paid each for their services here is rumored to be \$25,000 per annum, and may be even more, for no denial of the more modest estimate has been forthcoming from the American company. Our contemporary, the 'Journal of Industrial and Engineering Chemistry', takes exception to the action of the Dupont company and considers it unfortunate, viewed from any angle. It points out that an economic battle for the possession of the American market is in progress between the American and the German dye industry. Although in war-time, information is obtained, we are reminded, as far as possible from captured opponents, it is not usual to place renegades in positions of high command. Our contemporary regrets the policy of the Dupont organization, hitherto considered 100% patriotic, and views askance, as a matter of national concern, the demoralization in the ranks of American technicians in consequence of the lowered morale of the Dupont research staff. Whatever the ability of the two chemists, it concludes, however intimate their knowledge of special lines may be, it were better to send them home and let the American industry proceed to its full development in an American way and by the force of American brains. We find ourselves in full accord with the vigor of the closing opinion, for we would like to think that American effort can reach the top of the tree without help from German technologists; and we consider that if the Dupont company cannot compete with Germany, with the aid of unlimited

capital and American resourcefulness, there is something seriously wrong with its organization. We read in a San Francisco paper, which we are quite unable to designate as an esteemed contemporary, apropos of the baseless charge against Mr. Bernard M. Baruch: "Personal honesty is a luxury, and Mr. Baruch is rich enough to afford it." This, it seems to us, is a crude expression of the same sentiment as that prompting the engagement of the German renegades by the Dupont company.

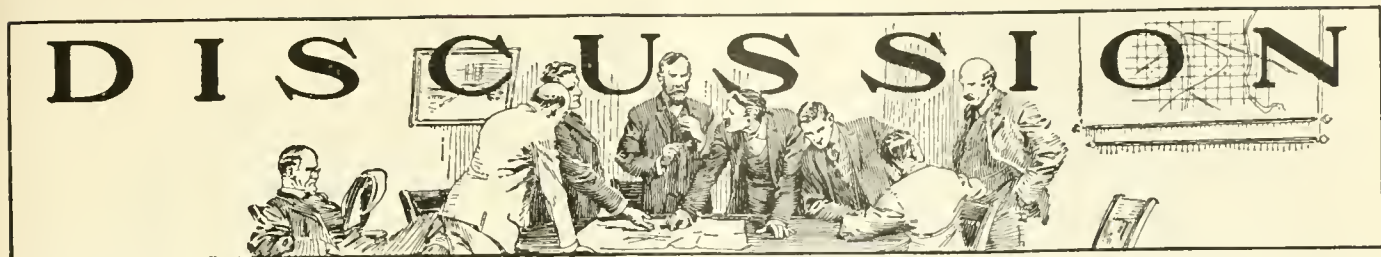
The Licensing of Engineers

In our last issue we published a summary of a law recently introduced in the Montana legislature providing for the creation of a State Board of Engineering Examiners for the purpose of licensing professional engineers. Accompanying the summary were affirmative arguments prepared by the Montana Assembly of the American Association of Engineers, who sponsored the bill, and a number of objections advanced by a committee of the Montana Section of our own Institute, included in which were a number of men who enjoy more than local prominence in the profession. Some fifteen States have made statutory provision for the compulsory registration and licensing of architects, and a less number have laws imposing similar requirements on engineers and land-surveyors. The American Association of Engineers, through its local assemblies, is advocating the passage of licensing laws in every State, the ultimate aim being to have one comprehensive statute applicable to members of all the engineering professions as well as to architects. We understand that Engineering Council, before it was dissolved, took cognizance of the movement in favor of licensing, by urging that engineers exert their influence to see that if laws were to be passed they might be good ones. The attitude of the Council was that laws would be enacted eventually and that it therefore behooved members of the profession to frame the measures themselves, rather than to leave the matter to those not qualified for the task. The question is asserting itself undeniably; it is one that commands the attention of every engineer. The importance of a favorable attitude on the part of the public is recognized, and in order to cultivate sympathetic relations, an appeal is made on the basis of public service; it is declared that the object of legislation is to "safeguard life, health, and property" by preventing the incompetent, ignorant, and unfit from practising. Analogy is drawn with the State regulations dealing with the practice of medicine, dentistry, law, and pharmacy. However, even at the risk of being thought cynical, we venture to say that the public welfare is a secondary, though important, consideration, and that the primary object of such legislation is to benefit engineers, both as a class and as individuals. Much the same motives are paramount in the minds of physicians when they oppose chiropractors. Nor is this unreasonable. Undoubtedly the obligatory compliance with certain standards of education and experience adds to the prestige of the doctor and the

lawyer, it gives them influence in the community and it enables them to sell their services to better advantage. Frankly, we believe that this is the purpose of the engineers who are favoring licensing laws; this they tacitly admit when they propose that the expense of administering the law shall be met by the engineers themselves; and in 'Professional Engineer', the monthly organ of the American Association, little attempt is made to conceal the fact. The relation between the medical profession and the public is different from that between engineers and the public, but there is certainly as great a difference in the relations of doctors and of attorneys, each with the public. On the whole, it is hard to see why engineers should not look confidently for a higher standing as a result of the general establishment of a licensing law.

Some divergence of opinion is evident as to just what policy is the best to follow in framing a satisfactory law. One proposal is to make it a misdemeanor, punishable by fine or imprisonment, to practise professional engineering without a license, 'practising' being so defined as to include only those in responsible authority. The effect of such a law would be to compel individuals or corporations to employ none but registered engineers in executive and authoritative capacities. Others take the view that it is unwise, even if it be possible, to interfere in any way whatever with the freedom of the private employer, as distinguished from the public officials, in the selection of those who are to do engineering work. They contend rather that legislation should be directed toward protecting the title 'professional engineer' by making it unlawful for a person not duly licensed to use the title or pose as an engineer. It would remain, then, to make the word 'engineer' synonymous with efficiency and competency in the performance of work requiring special knowledge and skill; it would be necessary for engineers themselves to aim constantly at higher standards of conduct in their technical and professional relations with the public, to the end that the right to use the title would connote ability and training. The committee of mining engineers mentioned criticizes the proposed bill for a number of reasons. First, it is declared to be poorly drafted; certain sections seem to be inconsistent with respect to each other; and the definition of 'engineering' is open to objection. However, these are not vital defects, and we believe that the proponents of the bill would accept gladly amendments designed to correct them. The second argument is that the law, if passed, will not exclude either the incompetent or unscrupulous practitioner. The report says, "Lack of employment does now, and will continue in the future to, curb sufficiently the activities of the incompetent engineer. The proposed law presupposes inability on the part of the employer to correctly judge the competency of his employee". Although there may be reason in this argument, it is nevertheless easy to see that much time and money now wasted in unearthing incompetency might be saved by a well-organized State board of examiners. One point that the mining engineers appear to have overlooked is the fact that State, county, and

municipal governments, which under any legislation should be compelled to employ licensed practitioners, do a great deal of engineering work. Occupants of lucrative and responsible positions are too frequently selected for their ability to construct political 'fences' rather than for any other engineering attainments. The financial loss to the public is not measured by the salary of the particular official, but by waste and inefficiency in the work under his direction. It is on this account that the problem becomes the concern of every tax-payer; the incidence, being through his pocketbook, is felt keenly. As for the unscrupulous engineer, the committee says: "The real injury to the engineering profession comes from men who are competent enough, so far as examinations show. Their sins are not mistakes but misrepresentations." Obviously it is difficult to exclude those who are inclined toward dishonesty; and, although provision is made for the revocation of licenses on the ground of fraudulent practice, such action on the part of the board is necessarily open to review by the courts, where legal proof is hard to establish. However, the existence of machinery for ventilating such matters in public would doubtless be a deterrent to some who otherwise might be tempted to deceitful acts; and, moreover, publicity would make the repetition of unscrupulous conduct by the same individual less likely. One outstanding mistake in the law as drawn is the exclusion of non-citizen engineers from practising in Montana. Apropos of this point, it is fair to remark that there are strong advocates for the entire disregard of the question of citizenship in issuing permanent licenses, and, furthermore, for some provision regulating the issuance of temporary certificates to foreign engineers who are to be retained for special work in this country. American engineers are permitted to practise their profession in every country in the world, with no restrictions other than that they behave themselves. There ought to be no discrimination against non-citizens; and we believe that this policy represents the best thought among those who favor licensing. In our opinion the most important fault of the Montana law is that it presumes to make obligatory the employment of none but registered engineers by private individuals and corporations. The time may come when such a law is desirable; indeed, with respect to certain prescribed kinds of work, compulsory employment of licensed engineers is provided in a number of States today. A successful law must be supported by the conviction and the goodwill of a liberal majority of the people, and in accomplishing any reform it is first necessary to overcome the inertia of indifference. The American Association of Engineers is a growing body of young men; it has enthusiastic leaders who are devoting a great deal of energy to the advancement of the welfare of engineers; among other things, to the passage of licensing bills. If a wise course is steered, and due regard is paid to the advice of the older members of the profession, the Association will doubtless accomplish what it has undertaken; and, as we have said, the prestige, the influence, and the standing of engineers ought thereby to be raised.



The Education of the Mining Engineer

The Editor:

Sir—Apropos of the discussion on this subject appearing in recent issues of your paper: there are fashions in education as there are in clothes. What then should be the fashion adopted for the training of the mining engineer? At present the latest word seems to demand a dress of liberal culture. We hear the cry to lay aside much of the drab tweeds of technical training and to substitute therefor the more comely garments of the humanities. In other words (if I may escape from this dress-maker's metaphor) there is agitation toward the widening of the curricula so that they may include such subjects as literature, history, and economics.

Most of us would subscribe quickly to the proposition that an engineer should be a man of culture. But what, pray, is culture?

When the world was young its people soon found it necessary to develop means of communication, so language and literature were born. When things started to happen, history began. Hence it is quite natural that a knowledge of these subjects was considered the criterion of culture, for the simple reason that they constituted the greater part of human knowledge.

As time went on, however, intellectual curiosity reached out its octopus-like tentacles to grasp a bit of fact here and a scrap of observation there and to carry them to its maw, where they were digested and made a part of the ever-increasing body of learning.

Yet the old badge of culture still survives. The man who talks of books and events holds his hearers spellbound. What a prodigy of wisdom! How different he is from yon silent individual among the listeners. Why has that person not improved his opportunities? He has, do you say, a deep knowledge of astronomy and geology and zoology? Then why does he not make the fine figure of the talker? Because others do not speak his language. A rudimentary knowledge of English suffices to make the speaker's points intelligible, but to understand our silent friend we must have studied a bit ourselves. He may, of course, descend to scientific baby-talk, but even that might tax the brains of the hearers and they would soon turn away.

So here we have two men versed in different subjects. Can the one who has never heard of the equation of time, or a plutonic rock, or natural selection, lay better claim to the medal of culture than he who knows naught of the 'Sentimental Journey' or the Hegira of Mohammed? Unfortunately, yes, for the guild of culturists is like

most exclusive societies: the charter members make the eligibility rules. They had a good many years start on the scientific fellows and became well entrenched amid their ancient lore before the upstarts applied for membership.

Are there not other possible attributes of culture? Why, of course, an appreciation of art and music and drama. What of manners? Is the learned doctor with the refinement of an orang-outang a model of culture? Hardly. Is not then our ideal of a cultured gentleman a sort of composite fellow: an Addison, a Newton, a Ruskin, and a Chesterfield all rolled into one?

Few of us can attain to this ideal in a lifetime of striving. How futile it is then to believe that four years of study in a university will enable us to gain the many-sided development that is demanded for true culture, and how infinitely more absurd it is to conceive that four or five courses squeezed into a mining program will accomplish this result. Education must be a continuous process, beginning with the dawn of consciousness and lasting till we cease to register.

Some twenty years ago I entered Harvard and was presented with a catalogue from which I was to select seventeen and a half courses. The completion of these courses would entitle me to a Bachelor of Arts degree with all the privileges and insignia pertaining thereto. The opportunity being at hand, I started to absorb such funds of information as had accumulated up to that time. Four years later I looked back along the way I had come. The gates of many pleasant gardens had opened to me but there had been time scarcely to glimpse their inviting paths. A few nuts of culture shaken down by perspiring professors had, to be sure, landed near me, but the great outstanding truth that had been forced upon me was the fact that the bounds of human knowledge transcend the vision of any one individual, and likewise, as a necessary corollary, that the fellow next to me is not necessarily a barbarian because he is not interested in the subjects in which I am absorbed.

In the light (or the shadow) of what has gone before, let us consider the work of the mining student. In his four-year program he completes about twenty full-year courses. The work of a mining engineer demands the study of mathematics, physics, chemistry, and a goodly number of subjects commonly included in the training of civil, mechanical, and electrical engineers. The substance of the courses in the last three branches, if analyzed, will be found to be an expansion of the course in general physics. In the program are also a few mining subjects. These usually include mine accounting and

mine economies. After all, economies is economies whether we speak in terms of copper and lead and miners, or of corn and wheat and factory workers. A lot of un-studied talk is made against "practical courses". I presume that the furor is really directed against courses in shoveling and single-jacking. No self-respecting school, however, can find time for such.

In mining we study subjects, not courses. It does not suffice the mining student to select an elementary course in geology and call it a day. The miner must study determinative mineralogy, crystallography, petrology, general geology, economic geology, and he must spend much time in the field. Moreover, even to begin this subject he must have a substantial groundwork of physics and chemistry. He must build a firm foundation of geological knowledge and methods upon which he may rear a more stately edifice from his later experience. And so with his other subjects, they are built up, course by course, until they become a power for accomplishment. In this process of foundation building, unless the teachers are much remiss the student cannot but gain the power of clear thinking.

It is footless to say that the boy needs no specific knowledge—just a broad (?) education. These students at graduation do not become captains of industry, they become the technologists of the mining business. Many of them by nature are fitted to remain technologists, and fortunately this is so, for if they all became general managers it would be embarrassing. One superintendent told me that he never hired students from a certain mining school because they had so many electives that he could never be sure that they would understand the subjects for which he wanted the men. Mining engineering and medicine are alike in that both require definite knowledge in certain fundamentals. Suppose a young mine surgeon was called to treat a man with a broken arm and the doctor should say that he had not elected the course in bone-setting and so could not help the man. Perhaps he could follow the example of the old physician who used to throw all patients into fits because he was 'hell on' fits.

Now it must be admitted that the courses in the mining curriculum embrace material that is ranked as basic in any educational scheme. If we agree that our specification of a cultured man calls for a knowledge of science as well as of letters, then if our mining students were studying solely to acquire culture they would be doing as much as is possible toward that end in the allotted time. Shall we be less thorough in order that we may bow to the popular delusion that the enrolment in four or five random courses constitutes the acquisition of culture? Rather let us find other times for other subjects. What of the student's years from six to eighteen? Is his training during this impressionable period filled with chaff? Is he guided by underpaid drudges? Cheek up those years and see to it that they are fruitful. The subject of English composition, for example, should have reached such a stage during this time that the student in college does not need additional instruction, but practice, in the art of writing. He should be capable of criticizing

his own work. We are burdened with men who during their school years have failed to meet their intellectual obligations and now expect the university to pull them out of bankruptcy.

Then we must not forget that we can leave a few things for the after-years. The reading of philosophy or the extended study of history might well engage our leisure moments.

Some claim that the engineering course should, like many law courses, be superimposed upon a more heterogeneous course. This might be arranged if all the mining schools made the same requirement. It was tried at Harvard and a vigorous school died from lack of students. Even assuming that the plan were feasible, it would have its difficulties. When the college graduate enters the law school he starts at once on his chosen subject and is carried along by its novelty and interest. In the case of a graduate entering a mining school, we have the condition of rather mature individuals with firm convictions as to their needs, forced into two years of elementary grind during which time they scarcely hear the word 'mining'. From my experience with this type of student, I would say that they will prove to be refractory ore. I would rather see the order of study reversed.

But, you may say, let them take the elementary subjects in the College of Letters. This is possible if they know what they are going to do and will follow advice. If they do this, their technical course will be shortened automatically. This amounts to the same as lengthening the four-year course to possibly six years.

In any lengthened course those with a love for learning will profit while others will take the uplift courses like so much castor-oil. There is a common misconception that students, if given the time, will browse in the library. Moose browse, students go to dances and play games. An extended course requires a lot of money. Many of the students, in the Western schools especially, are partly self-supporting. Their families, by great sacrifice, help them through four years. Any additional burden would mean that the boy would not go to college at all. Finally, in this connection, the young engineer must often spend the years of his apprenticeship in places where life is hard, so the sooner he gets out the better.

To those who are financially able and would really profit by additional years I would say, stay longer. To such men the mining school that is a part of a university offers unlimited opportunity. Speaking of this type of school brings to mind a point that should not be overlooked. A mining student in such a school will absorb much of other subjects from the inspiring activities of the place and from contact with his fellows in other departments. Gordon McKay realized this when he left a fortune to Harvard that a scientific school might be founded in the shadow of a great university.

Regardless of educational systems, some will be cultured and some will not. If we make a slight change in some lines in 'Fanny's First Play' perhaps they will express the real truth of the matter: "Unless people have"

the desire for culture "within themselves, all the earth, all the floods, and all the prisons in the world can't make them really" cultured.

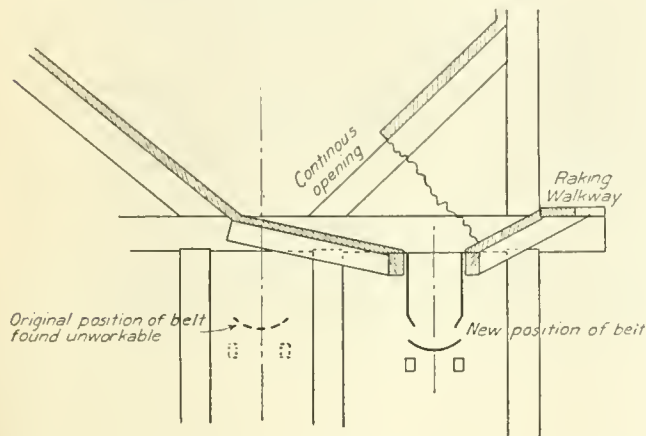
WALTER S. WEEKS.

University of California, February 14.

A Louvred Bin

The Editor:

Sir—The design of louvred bin given in your issue of January 15 is interesting, and suggests a valuable improvement on the design of bin indicated. Everyone who has handled ore, and especially run-of-mine, in such



bins, knows only too well the difficulty of maintaining anything in the way of a regular feed onto a belt-conveyor; in fact, even with the improvement shown, it is well-nigh impossible with the belt in the position indicated. In the accompanying sketch I give what, in practical experience, was found to be a big improvement on an almost similar bin to that you illustrate. The fundamental idea is to create what in hydraulics is known as a 'break-pressure' station in the stream of ore. It is true that a laborer has to keep the ore 'moving' above the feed-chute, but with the wide and continuous exit from the main bin this is an easy matter.

W. M. HUTTON.

Mexico, D. F., January 24.

Institute Affairs

The Editor:

Sir—It appears to be a matter of great importance by what means the A. I. M. E. may be extricated from its present state, toward which it has been drifting for some time. It is to be admitted that some mighty bright men have served as its presidents in the past several years, but we are also aware that such title is largely honorary, and that as such they have little to do with the policies outlined by the Board of Directors. Hence constructive criticism should be acceptable, more especially at the present time.

It appears to me, separated afar from its actual workings, except through correspondence, that, in the 38 years that I have been affiliated with this very able body of engineers, we have become unwieldy through the policy inaugurated that has produced our enormous

growth, which was intended to lessen costs that have nevertheless increased, either through natural causes or by reason of our being compelled to cater to the many different classes of engineers whom we have admitted to membership.

For some time it has been evident that unless these policies were changed, the A. I. M. E., would disintegrate. However, the preservation of the original ideals of the founders should be kept in view, and this can be done by utilizing the best talents of this body in solving the very grave problems now before it. In detailing some of our inefficiencies, I may say that the articles composing a great proportion of our volumes, and in some cases entire volumes, are upon subjects uninteresting to the rank and file. As compared with the earlier years of the Institute, editing appears to have been well-nigh discarded, in eliminating entire articles and in cutting down the remainder. The 'Magazine', one in appearance only, can be safely dropped in almost its entirety.

In addition to an authorized increase in annual dues, the Secretary has called upon the membership for a donation of \$10 each. Gifts can be only palliative and soon would require duplication. If we survive we must be placed upon the sound business basis from which we have departed, and to that end committees should be appointed, consisting of our most able men of each of the different classes of engineers and metallurgists, to go into conference and submit plans for the complete re-organization of the A. I. M. E., yielding to kindred organizations that portion of our membership that is entitled to such, in order that they may be treated more justly, and in justice to ourselves.

WALTER W. WISHON.

Searchlight, Nevada, February 21.

The Editor:

Sir—Recent editorials and correspondence in your paper in criticism of the management of the American Institute of Mining and Metallurgical Engineers suggest the tendency, inherent in all great organizations, toward the dissipation of energy and the distraction of attention to the detriment of the purposes for which they were founded. It is the penalty exacted by size, and a professional society can no more escape it than an overgrown university, state, or religion. Therefore I heartily second the proposal of your correspondent, W. O. Borchardt, in your issue of February 12, that the members "fill out a questionnaire, the results of which would serve as a guide to the authorities of the Institute in the re-consideration of the functions and activities of the Institute".

I must dissent, however, from your editorial comment of the same date that the Mining and Metallurgical Society of America "in its effort to be select has succeeded in being exclusive". The purposes of the Institute and those of the Society are quite distinct, the one seeking to benefit its individual members through the publication of technical papers, while the other ignores technology and concerns itself only with the profession and the industry

as a whole. I feel safe in asserting that the Society, so far from cherishing any ambition to be exclusive, welcomes to its membership every engineer qualified according to a standard no more exacting than that of any bar association or medical society. Since, however, in lieu of material advantages, it has to offer its members only the opportunity for unrequited and even unrecognized service, it cannot make a wide appeal and its ranks must remain thin for other reasons than choice.

Though addressed primarily to your personal attention you are free to use this in any way you may choose.

H. H. KNOX.

New York, February 16.

The Editor:

Sir—The discussion of Institute affairs, both editorially and by members who have taken the trouble to write letters on this subject, will doubtless result in some good; but I wish at this time to urge upon all members of the local section that they attend our next meeting on March 8, as it is quite likely we shall have a further communication from the office of the Secretary by that time, and at any rate, further discussion will result in healthy progress toward the desired end, which is a correction of the ever-mounting cost of membership in the A. I. M. E.

I agree with Mr. Borchardt that "abuses taken in time could have been corrected without disturbance", and those having at heart the prosperity and true success of the Institute should exert themselves, speak their minds, and aid, by concerted action, the laudable desire that has been voiced by our local section in asking the appointment of a committee to investigate the whole question of publication costs. So, therefore, let me urge upon every member of the local section that he set aside Tuesday evening, March 8, for attendance at the meeting of the American Institute of Mining and Metallurgical Engineers.

FRANK L. SIZER.

San Francisco, February 16.

Teaching Engineering Students to Write

The Editor:

Sir—In Homer A. Watt's interesting address, read before the National Convention of Business Paper Editors, which was published in your issue of February 5, he concluded by suggesting what editors might do toward encouraging engineers to express themselves clearly. As Mr. Watt says, editors already have done much in this direction, and, I might fairly add, probably no one more than yourself. Not only have you contributed two excellent text-books on the subject, 'A Guide to Technical Writing' and 'Technical Writing', but by editorials, by the publication of articles, and by the encouragement of discussion on the topic, you have kept the matter before the mining profession since you dropped the pick to take up the pen, some 18 years ago. What you and others have accomplished may be seen readily by comparing the leading technical magazines of today with those of twenty years ago. There is, however, one direction in

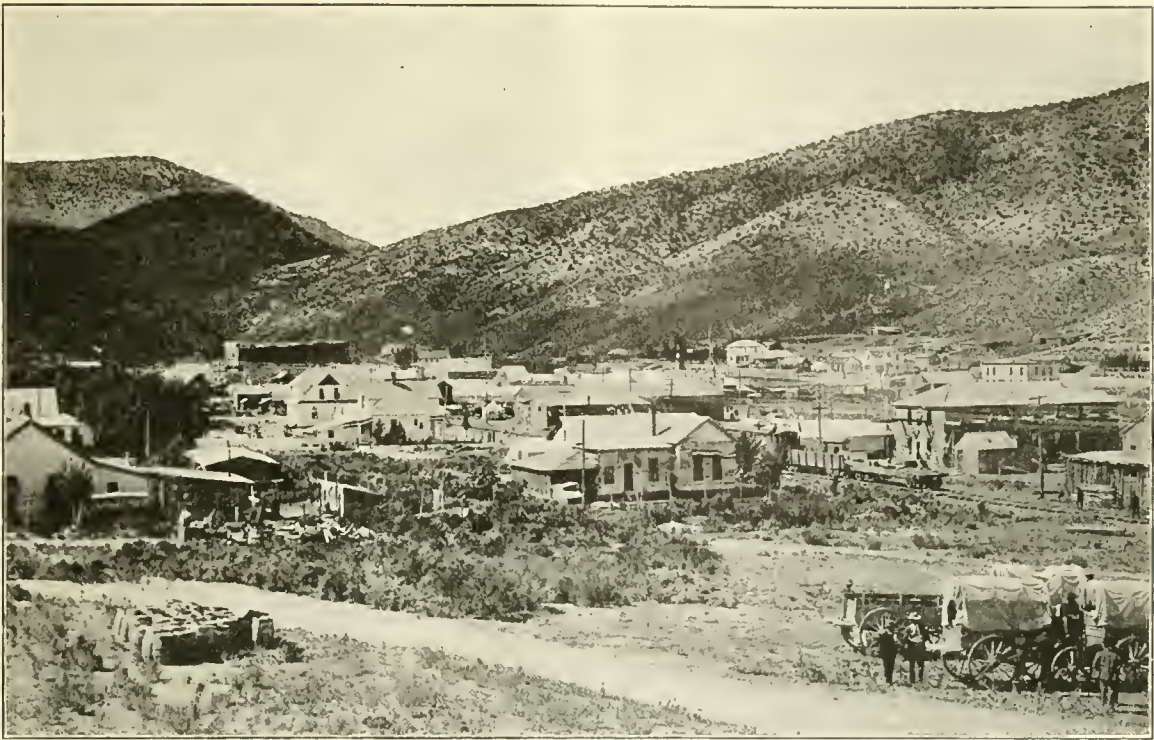
which I believe editors still might do much toward the advancement of technical writing, and that is by conferring and adopting a uniform style with regard to capitalization and the numbers of verbs governed by collective nouns.

As things stand today, nearly every technical paper has a style of its own. Particularly is this noticeable in the matter of capitalization and in the numbers of the verbs governed by and in the pronouns standing for collective nouns; and often there seems to be no consistency in this respect. One finds, for example, in the same magazine reference to John Jones, Minister of Mines, and William Smith, superintendent of the Bonanza mine; a delightful Province and a prolific country; the President and the king. British papers often have a way, like the muse of old, of emphasizing common nouns by capitalization, thus we find "Ontario could have three great Provincial Universities", "Both these Universities have a good Arts course", and "A chart has been prepared to accompany this Report". Editors particularly seem to be at variance as to whether state, province, dominion, and federal should be capitalized or not. Since we do not, as a rule, capitalize earth, world, and continent, there seems to be no good reason why we should capitalize the lesser divisions of them. I understand, of course, that one usually writes the State of California or the Province of British Columbia, in the same way that one writes Doctor Jones or Professor Smith, while one does not write John Jones is a clever Doctor, but some editors do not capitalize state and province even under these conditions. In many magazines and daily papers one finds such words as government and company indifferently followed by singular or plural verbs, and it is not uncommon to find both singular and plural verbs governed—or rather ungoverned—by the same subject. Such forms of writing lend variety, of course, but they are puzzling alike to the reader and to the contributor. The reader, especially if he also is a writer, is apt to fall into the Henry James habit, and find himself reconstructing the sentence, instead of attending to the text. In other words, it discourages concentration.

For the free lance, who may be writing for fifty or a hundred different magazines, it is quite hopeless to attempt to fall in line with the style of any one magazine; the only thing for him to do is to adopt a course of his own, and this often causes trouble and unnecessary labor in the editorial offices. It may be argued, of course, that when a man is writing for a particular magazine, in common courtesy to the editor he should try to adopt the style of that magazine, but, unless the work is being written to order, it often happens that an article written with a particular paper in view does not, for any one of a dozen reasons, meet the editorial requirements; consequently the article is returned, and ultimately may find a niche in a paper that has a totally different style to that for which it originally was written. Bearing this in mind, the value of a uniform style will be evident.

Victoria, B. C., February 15.

F. H. MASON.



ELY, NEVADA, FIFTEEN YEARS AGO. ROBINSON CANYON IN THE BACKGROUND

Nevada Consolidated Copper Company—I

History of the Enterprise

By Arthur B. Parsons

Mines are like men in that their early history becomes a matter of general interest only when fame and fortune have been attained. Great success in mature years lends the glamor of romance to a story that otherwise would be considered commonplace; it makes worth recording events that in themselves are not exceptional. The Nevada Consolidated had distributed \$45,269,023.85 to its shareholders up to January 1, 1920, and on that date still had a surplus of \$8,160,533.02 as a result of its operations over a period of 10 years. This alone should place the enterprise safely within the category of great mines, and thereby justify a glance at its early history.

The old residents of Ely, which since 1887 has been the county seat of White Pine county, Nevada, and which is about midway between Ruth, where the mines are situated, and McGill, the site of the mill and smelter, keep their memories fresh by recalling the following sequence of dates: '49, the gold rush to California; '59, the discovery of the Comstock; and '69, the great Hamilton-White Pine rush. Hamilton enjoys some conceit in the association, whereas Austin, Eureka, and Pioche, with no less claim to fame, are excluded from the trinity because their birth-dates lack the magic digit 9. The mines of Hamil-

ton, 25 miles west of the present Ruth, were among the most remarkable producers of high-grade silver ore of which we have record. Rich deposits of chloride and bromide ores were found at the grass-roots, and how many millions of ounces of silver bullion were shipped from Hamilton will never be known. The story is told that a mining man telegraphed to Government officials at Washington who were debating the advisability of resuming specie payment during the period of reconstruction after the Civil War, telling them to go ahead, because there was "enough silver in Treasure hill alone to pay the entire national debt". Tradition has it that this same telegram was used by the advocates of the gold standard in their successful campaign for the demonetization of silver, the event that put so many silver mines in Nevada out of business. Doubtless the importance of the part played by this innocent telegram is exaggerated; but the tale emphasizes the richness and extent of the ore deposits. It is said that a single chunk of almost pure hornsilver, or cerargyrite, weighing 2800 lb. and worth more than \$40,000, was taken from the Eberhardt mine.

The overland mail-stages from Hamilton to Pioche established a station on a small flat, where Robinson canyon

widens somewhat, several miles above the site of the present town of Ely. The old log stables where the relays of ponies were kept is standing today, and as one goes comfortably by in a motor car he may imagine the thrilling journey on top of a six-horse stage over the rough and winding road.

The miner has unrest in his soul; distance lends enchantment to the prospect of a fortune, and so it was that miners in Pioche felt the lure of Hamilton, while visions of greater bonanzas in Pioche appealed to those who were doing well in Hamilton. There was much traffic in both directions. On the way many tarried to prospect; some stayed for a week, some for years. Near the relay-station, called Robinson, grew Lane City, a town that is reputed to have had in its prime a larger proportion of saloons to total buildings than any other camp in Nevada—which, if true, must have established quite a record indeed. One or two abandoned shacks and a score of thrilling stories are all that survive of Lane City today.

Here the Robinson mining district was organized and much prospecting and some mining were done. In 1872, Aultman, of the Aultman Harvester Co., built a small lead smelter at Lane City, but it did not run long; a little later a man named De Long started a plant to smelt carbonate copper ore, but this enterprise came to a sudden end with De Long's death. Eureka, the nearest railroad point, was 90 miles distant over rough country. A narrow-gauge railroad reached Eureka from the Central Pacific, now the Southern Pacific, at Palisade. An alternative was Wells, also a station on the Central Pacific, which might be reached by a 150-mile wagon-haul down Steptoe valley. Incidentally this valley, now traversed by the Nevada Northern railroad, a subsidiary of the Nevada Consolidated company, can be traced as a continuous depression, under different names, from the Canadian to the Mexican border. Although the distance was greater, the journey down the valley with a loaded freight-wagon was easier than that to Eureka; the difference lay in the fact that one route was with, the other across, the contour of the country. Naturally only exceptionally rich ore could be shipped to the smelters in Utah and after the failure of the two small reduction plants at Lane City the efforts of the miners were directed to the search for gold, for which there were excellent prospects.

In 1880, Ellison Watson operated the Joanna gold mine, and soon after that W. N. McGill, J. J. McOmie, W. G. Lyons, and A. J. Underhill opened the Chainman mine and erected a 10-stamp mill to treat their ore at Ely. They had indifferent luck. Later, Charles D. Lane built a new mill on the property. This he sold to some capitalists from Elmira, New York, who erected a 100-ton cyanide plant about 1900. It was not a success, however. Indeed, at this time mining in the Robinson district did not wear a rosy aspect. Some silver ore from the Keystone, now owned by the Nevada Consolidated, had been hauled to Eureka by Featherstone & Reynolds, but there was little ore that could stand the cost of transportation by team.

However, if the pioneers of Ely, which had then become the business centre of the district, had not been prospectors at heart, they would never have been there at all; so with the persistence that comes only from faith that a fortune awaits the pick and that 'high-grade' may be found with the next round of holes, they continued to dig into every likely-looking outcrop. There was plenty of low grade copper, and in many places gold and silver ores were found, but they were not rich enough to ship; they were just good enough to warrant a real miner in going ahead.

One of these was D. C. McDonald. Mr. McDonald is Justice of the Peace at Ely, and has been Mayor. He is a highly respected citizen and a genuine optimist. He believes there are other mines just as good as the Nevada Con. in the Ely district; one of them is the McDonald-Ely. The fact that the McDonald-Ely is named for, and partly owned by, Mr. McDonald is by no means the only reason for Mr. McDonald's faith; it is to be hoped that it may some day be vindicated, for no one deserves to open a bonanza more than the ex-Mayor of Ely.

To revert to 1897. In that year Mr. McDonald had located two claims on some comparatively lean quartzite croppings two miles above Lane City. He hoped to find gold and silver ore to treat in a cyanide plant that stood on the property of the Salt Lake Mining Co., now owned by the McDonald-Ely company. One claim was named Kearsarge, and the other Ruth, after Mr. McDonald's young daughter. A wonderful mine and a thriving town of several thousand people now bear the same name as the claim christened in honor of Ruth McDonald.

Mr. McDonald later took into partnership with him Walt Rynearson and George Marks, then superintendent of the Robust, and they did some desultory prospecting without finding gold or silver in sufficient quantity to be worth while.

Three years later Dave Bartley and Edwin F. Gray arrived in Ely, to go to work underground in the Chainman. They were young, healthy, husky, and financially 'broke', having come from Shasta county, California, where they had been working in various mines near Redding. Before going to work, however, they decided to get a general idea of the district. As a result of a couple of days observation they were so impressed with the possibilities that they decided to get an option on a claim; while one of them developed it, the other would work for wages at the Chainman to supply 'grub', powder, and steel for the lease.

It happened that among other claims Mr. McDonald had shown them the Ruth, the Kearsarge, and the Hidden Treasure. Mr. McDonald says that Gray wanted the Hidden Treasure, but that he himself preferred to get rid of the Ruth and Kearsarge, so he finally agreed to give Gray and Bartley a lease and bond on the two claims for \$3500. In relating the incident, he remarks frankly that he didn't try to drive a hard bargain because he wanted two vigorous and willing young miners to go to work on development. If they found anything it would help the district, and that, indirectly, would help him. That is a kind of co-operation that counts, and I quite

believe that Mr. McDonald acted just as he says he did. Mr. Bartley declares that after the transaction was closed, and he and his partner were alone, Gray asked him what he thought of the claim. Bartley replied, "If she's good for anything, it's copper." There was some slight indication of copper, but it is probable that the fact that Bartley had just come from a copper-mining country had something to do with his predilection for a metal that was much despised around Ely. For example, at this time Mr. McDonald could have purchased a half-interest in the Star claim, now in the heart of the Copper Flat steam-shovel pit, for \$500, but in preference he took the Roadside claim, on which some silver ore had been found. Whether Bartley's insight into the geology of the deposit, or simply a good 'hunch', prompted his remark, he spoke with the wisdom of an oracle.

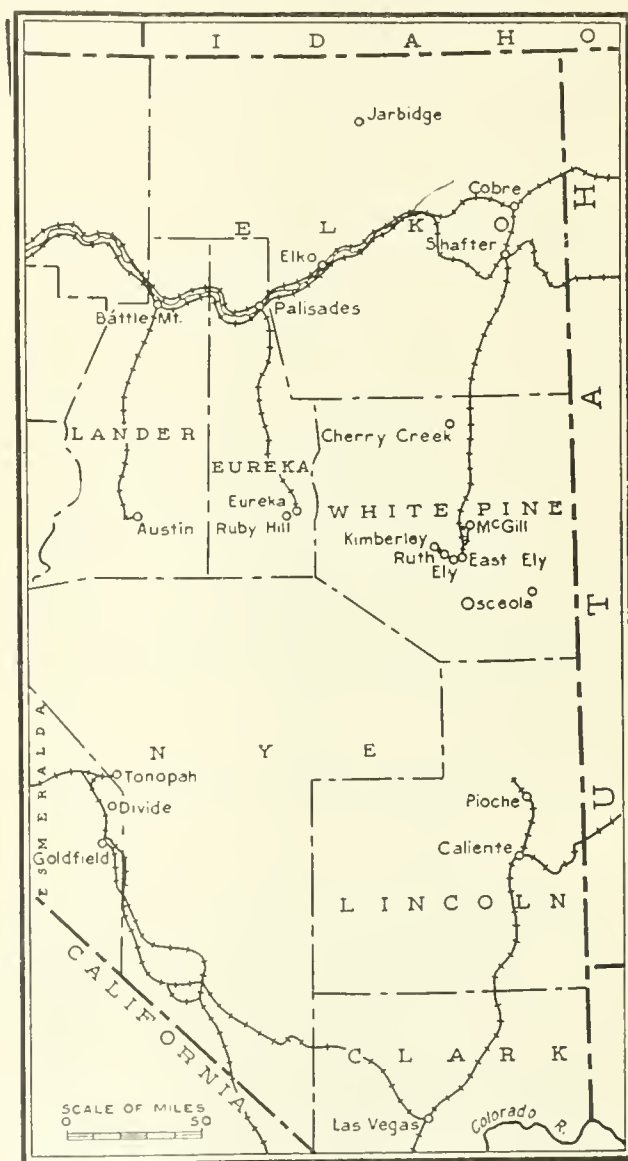
Gray started an adit on the Ruth claim, while Bartley went to work at the Robust; he worked here only a short time, however, for W. B. Graham, who ran a general store in Ely, undertook to give them credit and furnish supplies for the work in the adit. Graham continued to carry them for two years, with no security but the word of the two men. Bartley says that he occasionally went around and offered to go to work for wages for a while at one of the small mines, in order to earn some money to cut down their indebtedness, but Graham invariably replied, "I'll holler when I get seared." He never 'hollered'. Graham now owns the 'Quality Shop', a store on the main street of Ely that purveys clothes and haberdashery to the men-folk of Ely and Ruth.

Working in this way, Gray and Bartley drove their adit 315 ft. and then sank a 200-ft. winze. A number of drifts and cross-cuts were run and practically every face was in rock containing 2 to 4% copper. The enterprise was attractive except for one thing, namely, the 150-mile haul to the railroad. Gray and Bartley interested a number of capitalists, who sent engineers to examine the mine. John W. Gates, of Chicago, had an engineer look it over; John Treadwell came from San Francisco to see the property and was favorably impressed. Various other examinations were made, but that long journey down Steptoe valley was always the stumbling-block. The partners mortgaged the mine to W. G. Lyons in order to take up the bond with McDonald, and continued to live on bacon, beans, and work, confident that the right man would finally come along.

In the meantime Joe Bray, of Austin, Nevada, had become interested in the Copper Flat group of claims lying about a mile west of the Ruth. They were controlled by Newt Boyd and Thomas Rockhill, who had done some development on the Eureka and Star of the West claims. Bray organized the Copper Flat Mining Co. and later interested W. H. Hook, Martin Mulford, and John A. Traylor, now the well-known manufacturer of machinery, who joined in the formation of the New York & Nevada Copper Co. to develop and operate the Copper Flat property.

Hook wanted to get control of the Ruth group, and waited patiently for Gray and Bartley to abandon the idea of getting the price that they were asking and sell

out on his terms. He was confident that they would become discouraged. Gray and Bartley, however, instead of sickening of their task kept steadily at work until, at a depth of 300 ft., they entered copper ore far richer than any that had been found before. They were a hospitable pair; in the first place, they were that way by nature and habit, and, in the second place, they had nothing to hide; in fact, they wanted everyone to know just how good their mine looked. Anybody who hap-



MAP OF EASTERN NEVADA

pened around was welcome to go into the mine and help himself to samples, wherever and however he pleased. An old Comstocker named Williams was an occasional guest for several weeks; he ate beans and 'swapped yarns' with the boys and incidentally moiled a few samples here and there. He seemed to have no particular business, and Gray and Bartley rather missed his company when he left as unceremoniously as he had appeared.

The stage was now set for the arrival at the Ruth mine of a mysterious stranger one bright day in the autumn

of 1902. The interview is described by Mr. Bartley as being brief and decidedly to the point. The traveler, a brisk businesslike gentleman, introduced himself, and without further ceremony asked, "Boys, what do you want?" "\$150,000." "All right, let's go to Ely and fix up the papers." Mark L. Requa's recollection is not as clear regarding this conversation as it should be, in view of the fact that he was the mysterious stranger, but he does remember that the transaction was concluded in a single day and that the negotiations were brief. Mr. Requa knew all about the property and what he was prepared to do before he talked to Gray and Bartley, and they know exactly what their price was, so that the usual bargaining was unnecessary. It should be mentioned that Williams had visited Requa at San Francisco in more than a casual way after leaving Ely.

Requa did not then see success; what he saw was an undertaking so alluring in its possibilities that it was a good speculation to risk money in getting control of the property as a preliminary to solving the problem of its exploitation. Gray became superintendent of the Ruth mine, in which capacity he served until 1907. He is now superintendent for the Gray Mining Co., at Contact, Nevada. Bartley drops out of the story of the Nevada Con., though not out of the life of Ely. He is now proprietor of the Steptoe Drug Co. and enjoys the esteem of the citizens of Ely both as a business man and a friend. His popularity is attested by the fact that everybody in Ely knows him as 'Dave'. He says that he owns a drug-store for two reasons, first, he likes Ely and wants to stay there, and, second, because he never could stand to be idle and the drug business happened to offer itself at an opportune moment.

Requa organized the White Pine Mining Co. and soon after enlisted the assistance of F. W. Bradley and John H. Mackenzie. They started to determine what the copper tenor of the mined ore would be; to this end they sank, drifted, and cross-cut during 1903. Early in 1904, Bradley and Mackenzie sampled the Copper Flat group in anticipation of a possible consolidation of the New York & Nevada and White Pine companies.

Under date of January 29, 1904, Harold A. Titeomb, reporting to A. Chester Beatty, then assistant consulting engineer for the Guggenheim Exploration Co. under John Hays Hammond, declared that Mr. Requa was rather sceptical as to the ultimate success of any plan to exploit the deposits; he advised Mr. Beatty, however, to take this apparent pessimism *cum grano salis* in view of the fact that Requa had interested two such competent engineers as Bradley and Mackenzie and that they were making an exhaustive examination of the Copper Flat claims near-by. It is nothing to the discredit of Requa that Titeomb's diagnosis of the case was evidently quite sound.

During 1904, under the supervision of J. B. Fleming, a small experimental concentrator was erected at the Ruth mine to determine by actual mill-test what proportion of the copper could be recovered. The tests included 48 distinct runs on separate lots of ore taken from differ-

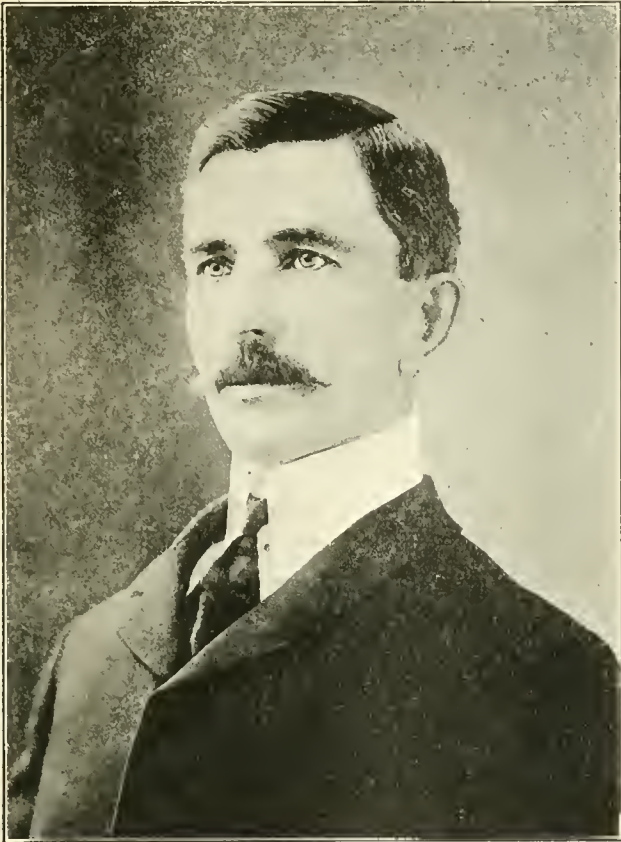
ent parts of the mine. The method of obtaining the ore was to cut a uniform amount per linear foot from the various workings. The result was a large-scale check on the mine-sampling as well as a metallurgical trial. The plant was started on September 11 and ran without interruption until December 1. The gross weight of the crude ore treated was 751,695 lb. From this 114,529 lb. of concentrate was obtained, the average ratio of concentration being 6.56:1 and the actual recovery 79.70%. The heads averaged 2.625% copper and the concentrate produced varied from 8 to 15%. The copper minerals in the ore were carbonates, silicates, sulphates, and sulphides, the oxidized minerals being in greater proportion in the ore from the 200-ft. level. The extraction, of course, was better on the ore from the lower levels. The summary of 23 samples from the 500-ft., or lowest, level shows:

Copper in crude ore.....	2.56%
Copper in tailing.....	0.61%
Copper in concentrate.....	13.06%
Actual extraction.....	74.79%
Ratio of concentration.....	7.09:1
Total weight of ore.....	465,685 lb.
Ore per linear foot of sample.....	825 lb.
Iron content of concentrate.....	22.00%
Sulphur content of concentrate.....	27.50%
Silica content of concentrate.....	30.00%

A better average recovery was obtained from the ore taken from the 300-ft. level, but the grade of the concentrate was not so good. A number of exceptionally poor runs also brought down the average extraction on the ore from the bottom level. In the meantime a number of claims were obtained by purchase and option and were added to the Ruth group. The owners of the Copper Flat claims, encouraged by the activity of Bradley and Mackenzie, also extended their holding as much as possible so that by far the greater part of the really valuable territory in the district had been included in one or the other of the two groups. The Giroux mine, which formed the nucleus of the present holdings of the Consolidated Coppermines Co. at Kimberly, 3 miles west of Ruth, was the only other property that developed an orebody of real importance.

Mr. Requa deserves a large measure of credit for his part in the undertaking. He was the man who visualized the magnitude of the deposit; it was through his initiative that Messrs. Bradley and Mackenzie were induced to participate and the enterprise was started on its way to success. In the 'Mining and Scientific Press' of November 3, 1906, he says: "I saw before me a mineralized zone wherein the question of tonnage had even at that time [1902], to my mind, been entirely eliminated. The unknown coefficient for which I was searching could only be determined by extensive development work; that coefficient was the average copper content of the porphyry in large masses. I had seen upon the surface streaks of high-grade ore that in themselves were interesting, but which did not hold forth prospects of a tonnage sufficiently large to justify the expenditure that I knew must be made in order to put the copper into marketable form. I saw in those early days that the only hope for this dis-

triet was in developing tonnage of such magnitude and value as would justify the building of a railroad from the Southern Pacific. This meant the building of a line



A PHOTOGRAPH OF D. C. M'DONALD TAKEN IN 1900

approximately 150 miles long, to justify which would require the development of millions of tons of copper-bearing ore. I had crawled down the Ruth mine 300 ft. on the incline and seen 40 ft. of a cross-cut that averaged approximately three per cent, with apparently no end in either direction. I had seen this same porphyry upon the surface leached of its copper, extending for hundreds of feet in width, and I knew that underground development would reveal enormous masses of this material, but I did not know what the copper content of it would be. It was, therefore, necessary first to develop this ore and determine its value not only sufficient-ly to justify the building of a railway, but sufficient in quantity to justify an enormous reduction plant, because profits could not be hoped for unless ore was handled by the thousands of tons per day. Over a period of two years this prospecting work was ear-ried on until a large tonnage of ore was developed. Even then, the railway was not justified, because there was no eer-tainty as to what could be done with

the ore in concentration. To determine this factor, a small experimental mill was built at the Ruth mine, which was operated during a period of three months, and most exhaustive tests and determinations made. The entire mine, in fact, was sampled by means of this mill; the results were compared, tabulated, and carefully scrutinized. That these results were satisfactory, is proved by the building of the Nevada Northern railway, which was undertaken immediately after these mill-tests were completed." This was in December 1904.

On November 27, 1904, the Nevada Consolidated Cop-per Co. was incorporated for \$5,000,000 and on January 5, 1905, the property of the White Pine Copper Co., formerly the White Pine Mining Co., and that of the Boston Nevada Copper Co. were transferred to the Nevada Consolidated. Requa and his associates were assisted in financing the enterprise by James Phillips Jr. (who became president of the company), W. Hinekley Smith, Charles Hayden, and others. At the start Requa was manager, while J. Parke Channing and F. W. Brad-ley were consulting engineers. Thomas W. Cox was metallurgical engineer. The first project, as Requa points out, was to build the railroad. The track reached McGill, the smelter-site, in July 1906, and on September 29 the completion of the line to Ely was celebrated.

A number of well-known engineers examined the prop-erty during 1905 and 1906, and a good idea of the enter-prise as it looked then may be gained from their reports. The property consisted mainly of two groups of claims. In the Ruth group were 19 patented claims aggregating 304,558 acres, while the Copper Flat group comprised 7 patented claims with an area of 133.3 acres. In addition, there were sundry possessory and option claims that brought the total area to about 1000 acres. The com-pany also had virtual ownership of the water in Murray creek, which supplied 4,000,000 gal. per day of good



DAVE BARTLEY AND EDWIN F. GRAY

water, and some 3600 acres of land suitable as sites for a mill and smelter. One of the earliest reports is that of J. Parke Channing, who on August 3, 1905, wrote:

"Without at this point going into the details by which I have arrived at my conclusions, I am of the opinion that with an expenditure of \$1,225,000 to build and equip the railway from Toano [near Cobre on the Southern Pacific] to the mines and with a further expenditure of \$975,000 to equip the Ruth mine, build a concentrator, a powerhouse, a smelter and the necessary shops, buildings, etc., making a total of \$2,200,000, that the property can be put in such a condition that one would be able to mine and treat a thousand tons of ore per day, which would produce copper at the rate of 13,700,000 pounds per annum. With copper selling at thirteen cents per pound in New York, the net annual profit from the mine and railway would be \$725,000. This consists of \$475,000 from the mine reduction works proper and \$250,000 net earnings from the railway. Should copper continue at its present price of fifteen cents per pound, the annual profits including that received from the railway would amount to \$1,000,000.

"By the further expenditure at this time of \$500,000 for the equipment of the Eureka mine and the enlargement of the mill and smelter, another thousand tons of ore per day could be treated, which would yield about 18,000,000 pounds of copper additional per annum . . . If, however, copper continued at fifteen cents per pound, this additional profit would be \$1,050,000 per annum."

Discussing the geology of the property, Mr. Channing says:

"During the summer of 1904, a careful geological survey and map of the district within which the mines of the company exist, was made by Prof. Andrew C. Lawson, of the University of California. Briefly stated, this report shows that the copper-bearing rock of the district is an immense porphyry intrusion, cutting through the limestone and shales of the country.

"This porphyry is a white silicious rock which on the surface is weathered brown with but little trace of copper. Where orebodies have been developed, as a general rule the first 50 ft. to 100 ft. of the porphyry has been leached and carries but little copper, probably not to exceed 0.5%. On getting below this zone of oxidation, the ore becomes white and comparatively soft in texture, so that it is drilled and blasted with great ease. The principal minerals contained in the silicious gangue are pyrite or sulphide or iron and chalcocite or sulphide of copper. These minerals occur in fine seams and veinlets and also in small masses with which the ore is peppered.

"The walls of the orebodies or masses are not well defined—pay-ore gradually merging off into that which is too low to be commercially valuable, and it is doubtful even if the low crosscuts in either the Ruth or Eureka mines have passed beyond the limits of pay-ores. At the Ruth mine the orebody varies from 50 to 250 ft. in width, and developments have so far shown from 500 ft. to 900 ft. in length, and a vertical height of 250 ft. At the Eureka mine the orebody has been opened up for a

length of 700 ft. east and west, and 800 ft. north and south, and has been proved to be of commercial grade for a depth of at least 100 feet.

"Not one hundredth part of the porphyry exposed on the claims of the company has been explored, and therefore, it is difficult to say how much of this porphyry may not be mineralized. The 50 ft. to 100 ft. of surface oxidation has deterred prospecting, and it is for this reason that the enormous ore deposits of the district have been undiscovered until recently. The geological conditions and the ore deposits are very similar, in fact almost identical with those in the Clifton district of Arizona upon which are located the mines of the Arizona Copper Company, the Detroit Copper Mining Company, and the Shannon Copper Company. In fact, it would be almost impossible to distinguish the ores of the two districts from each other when placed side by side.

"My opinion of the district is that the orebodies will be found of great lateral extent, that their upper boundary will be from 50 ft. to 100 ft. below the surface and that the lower boundary will be from 300 to 400 ft. below the surface, thus giving an average thickness of ore from 250 ft. to 300 ft. vertically. In this respect the orebodies closely resemble the iron ore deposits of the Mesaba Iron Range, in Northern Minnesota. This same phenomenon of great local extension and comparatively small depth also exists in the Clifton district of Arizona, and is one of the things which lead to such low mining-costs in both the Clifton district and the Mesaba Range. There is a deep-rooted idea that a mine to be good must persist in depth, but I wish to call particular attention to the fact that in this district the ore persists in a horizontal instead of a vertical direction, and that this is a most distinct gain when it comes to the extraction of the ore. In fact, as will be later called attention to, it is proposed to mine the ore of the Eureka Mine by an open-cut."

Mr. Channing mentions the geological survey made by Mr. Lawson, Professor of Geology in the University of California. I may add that the detailed information found in his maps and report has been of remarkable service to the operating officials in guiding their development work. He distinguished between two types of porphyry; one offered promise of profit, the other did not, and the outcome of exploratory work has amply verified the accuracy of this classification. Geological work is of greatest practical value when it actually assists the miner in finding the ore, and that is what Prof. Lawson's early survey has done, most effectively.

Mr. Channing's estimate of the ore developed follows:

"From calculations of the assay maps and from my own work, I am of the opinion that the ore of the Ruth mine will average 2.6% copper; 0.02 oz. gold and 0.05 oz. silver per ton of 2000 lb. Assuming the ore to extend 30 ft. above the 200-ft. level and 30 ft. below the 500-ft. level, we have a total vertical height of 242 ft. and I estimate that there is developed in the Ruth mines 2,400,000 tons of ore of the above average grade.

"In this mine I sampled and assayed 160 ft. of drifts and cross-cuts, my average being 2.331% copper as



THE EUREKA-ELY MAIL-STAGE ON ITS LAST TRIP, ON SEPTEMBER 29, 1906

against the mine average of 2.320% copper, which gives a practical check. From an inspection of the mine maps and assays and from my own work, I am of the opinion that the ore developed in the Eureka mine will average 2.2% copper, 0.02 oz. gold, and 0.03 oz. silver per ton of 2000 lb.

“The Eureka shaft went through 70 ft. of capping before it got into the unaltered sulphide ore, so that at the shaft one may figure on 100 ft. vertically of ore. The four different raises put up show a height of ore varying from 40 ft. to 70 ft. and I therefore assumed that there is 70 ft. of ore available above the 170-ft. level. On account of water and slow draining of the ore below the 170-ft. level it has not been practicable to put winzes down below this level, and I therefore have not assumed the ore as continuing more than 30 ft. below the level. On this assumption, which I consider extremely con-

servative, there is developed in the mine 3,200,000 tons of the above mentioned grade of ore.”

It is interesting to compare these figures with those given in the report of Henry Krumb, dated March 20, 1906, only seven months later. He finds in the Ruth mine 2,607,000 tons of ore averaging 2.4% copper and in the Eureka mine 5,138,000 tons of completely developed ore with 3,000,000 additional tons of reasonably certain ore below the 170-ft. level, making a total of 8,138,000 tons averaging 2% copper. Instead of 1000 or 2000 tons per day he estimates a minimum daily output of 5000 tons of ore, one-fourth of which would come from the Ruth underground mine. In conclusion he says, “I beg to state that the mines are only partially developed, yet with an annual production of 1,800,000 tons there are already 5½ years supply of ore assured. With six months of energetic development work this sup-



INTERIOR OF A ‘HOTEL’ IN ELY. MANY OF THESE THRIVED DURING THE RUSH FOLLOWING THE COMPLETION OF THE NEVADA NORTHERN RAILWAY

STATISTICS SHOWING PRODUCTION, COSTS, AND ORE-

Year	Tons of Ore In Reserve At End of Year	Average Percentage Cu. Per Ton Ore In Reserve	Dry Tons Ore Milled	Average Tons Ore Milled Daily	Average Percentage Cu. Per Ton Ore Milled	Lbs. Cu. Recovered Per Ton Ore	Percentage of Cu. Recovered	Total Net Lbs. Cu. Produced	Average Cost Per Lb. Cu. Produced After Crediting Pre- vious Metals & Misc. Income
1907	14,432,962	1.97 %							
1908	20,000,000	1.94 %	118,888		2.38 %	31.48 lbs.	65.50%	3,410,495 lbs.	6.42 ¢ (b)
1909	29,000,000	1.94 %	1,082,909	2,919	2.34 %	33.10 lbs.	70.73%	33,283,348 lbs.	7.47 ¢ (b)
1910	40,360,823	1.70 %	2,237,028	6,129	2.06 %	28.67 lbs.	69.59%	62,772,342 lbs.	7.05 ¢ (b)
(a) 1911	40,853,371	1.66 %	3,338,242	9,146	1.80 %	24.33 lbs.	67.59%	78,541,270 lbs.	6.97 ¢ (b)
1912	38,853,551	1.67 %	2,852,515	7,815	1.692%	23.10 lbs.	68.25%	63,063,261 lbs.	8.33 ¢ (b)
1913	39,108,590	1.65 %	3,139,137	8,600	1.599%	21.91 lbs.	68.52%	64,972,829 lbs.	9.51 ¢ (b)
1914	41,020,296	1.68 %	2,640,294	7,234	1.483%	20.31 lbs.	68.48%	49,244,056 lbs.	9.82 ¢ (b)
1915	50,525,289	1.652%	3,081,520	8,442	1.54 %	21.62 lbs.	70.18%	62,726,651 lbs.	8.23 ¢ (b)
1916	67,993,117	1.59 %	3,922,634	10,747	1.632%	24.12 lbs.	73.87%	90,735,287 lbs.	8.96 ¢ (b)
1917	70,025,322	1.58 %	4,064,095	11,131	1.462%	21.36 lbs.	73.08%	82,040,508 lbs.	11.68 ¢ (b)
1918	68,549,644	1.57 %	3,999,526	10,957	1.506%	20.26 lbs.	67.28%	76,607,062 lbs.	15.69 ¢ (c)
1919	66,414,219	1.563%	2,135,425	5,850	1.599%	22.54 lbs.	70.49%	43,971,892 lbs.	16.14 ¢ (d)
Totals			32,612,213					711,369,001 lbs.	

(a) The 1911 operations are from October 1, 1920, to December 31, 1911.

(b) Includes depreciation of plants and equipment and all taxes.

(c) Includes depreciation of plants and equipment and all taxes, except Federal.

ply could easily be doubled." As a matter of fact, within a little more than a year the proved ore-reserves were in excess of 20,000,000 tons of ore averaging 1.9% copper.

The story of the Nevada Consolidated enterprise would be incomplete without some allusion to the Cumberland-Ely controversy. The Guggenheims held 400,000 shares of Nevada Consolidated stock, which they had purchased at \$12.50 per share. They also owned a controlling interest in the Cumberland-Ely company, which, in addition to a considerable number of outlying and undeveloped claims, had acquired from W. N. McGill an option on his ranch 13 miles below and on the opposite side of Steptoe valley. The option also included McGill's water-rights on Duck creek. The Cumberland-Ely company had been organized by W. B. Thompson, George E. Gunn, and others, as a consolidation of a number of small companies whose holdings lay on both sides of the Nevada Consolidated ground. After the Guggenheims had purchased a large block of the stock at a price around one dollar, the shares became active on the market, treasury stock was sold at a good price, and the company accumulated some \$3,000,000 in cash in its treasury, its other assets being McGill's ranch, with its excellent water-rights, and a large area of ground which might or might not prove to contain valuable ore. The Guggenheims thereupon determined to consolidate the two companies, the Cumberland-Ely and the Nevada Consolidated. This course they justified by pointing out that the developed reserves at that time did not exceed 8,000,000 tons of ore averaging approximately 2% copper. At the prevailing price for the metal this did not assure profit sufficient to pay for the necessary mill and smelter; moreover, porphyry copper mines were then a practically unknown quantity from the capitalist's point of view; accordingly the Guggenheims argued that, rather than invest several millions more to finance the construction of the metallurgical plants, they would get the three millions in the Cumberland-Ely treasury by the simple process of a merger.

Moreover, they professed to believe that there was a reasonable chance of finding large orebodies in the Cumberland-Ely ground. Furthermore the McGill water-right was claimed to be superior to that of Murray creek for the reason that the requirements of the town of Ely for domestic purposes had priority over the needs of the smelter. The late Curtis H. Lindley, attorney for the company for many years, advised that the claim of the townspeople came first.

On the other hand, Mr. Requa, Mr. Bradley, and their associates opposed the consolidation. They contended that the proposed terms of the merger were far from equitable; they saw immense advantages to be derived by Cumberland-Ely at the expense of Nevada Consolidated, and, of course, to the disadvantage of such Nevada Consolidated stockholders as did not own stock in Cumberland-Ely. They believed that Nevada Consolidated owned practically all the valuable mining ground and quoted A. Chester Beatty as declining even to look over the surface because, as he said, "The Cumberland-Ely ground in my opinion is principally scenery." Requa and his friends maintained that there was plenty of water in Murray creek to supply a city of 50,000 and leave enough for metallurgical requirements, and that the Duck Creek water-right was being used as a subterfuge to compel the consolidation. The objection to the mill and smelter site at McGill was the 13-mile haul down Steptoe valley, which was particularly disadvantageous because of the low grade of the ore.

Glancing ahead for a moment, it will be interesting to note what subsequent events disclosed regarding the points under controversy. Mr. Beatty's pleasantry regarding "scenery" was a casual remark, of course, simply indicating the lack of knowledge concerning definite orebodies at that time. As a matter of fact, prior to 1914 approximately 1,000,000 tons of 3% ore was taken from the Veteran mine, one of the Cumberland-Ely properties, at an average cost of \$1.785. The mine was shut-down at the beginning of the War on account of

RESERVES OF THE NEVADA CONSOLIDATED COMPANY

Average Price Per Lb. Cu. Produced	Net Profit, Misc. Income Dividends on Invest- ments, Etc.	Earnings Per Share	Disbursements to Stockholders		Surplus From Operations at End of Year	Quick Assets Over Quick Liabilities		Year
			Total	Per Share		Total	Per Share	
13.00 ¢	\$ 224,687.88							1907
13.00 ¢	\$ 2,061,870.21	\$ 1.03			\$ 2,084,408.73	\$ 2,510,793.72		1908
12.75 ¢	\$ 3,580,786.90	\$ 1.83	\$ 2,982,644.48	\$ 1.50	\$ 2,557,061.71	\$ 2,633,617.31		1909
12.50 ¢	\$ 4,336,216.62	\$ 2.17	\$ 3,746,894.63	\$ 1.875	\$ 1,828,781.77	\$ 2,241,872.13		1910
15.979 ¢	\$ 4,823,839.23	\$ 2.41	\$ 3,998,865.60	\$ 2.00	\$ 3,172,177.25	\$ 3,324,236.45		1911(a)
14.879 ¢	\$ 3,483,886.33	\$ 1.74	\$ 3,998,913.99	\$ 2.00	\$ 3,069,643.02	\$ 3,557,119.94		1912
13.396 ¢	\$ 1,763,020.58	\$ 0.88	\$ 2,249,389.11	\$ 1.125	\$ 2,290,626.15	\$ 3,191,444.20		1913
17.647 ¢	\$ 5,905,601.87	\$ 2.95	\$ 2,999,185.49	\$ 1.50	\$ 4,849,555.79	\$ 5,732,521.71		1914
25.83 ¢	\$15,435,359.14	\$ 7.72	\$ 7,497,963.25	\$ 3.75	\$12,353,643.04	\$13,096,822.40		1915
23.75 ¢	\$ 9,408,892.72	\$ 4.71	\$ 8,297,746.55	\$ 4.15	\$13,180,525.97	\$14,301,422.85		1916
21.049 ¢	\$ 3,252,070.53	\$ 1.63	\$ 6,498,235.25	\$ 3.25	\$ 9,934,361.25	\$11,436,903.69		1917
18.666 ¢	\$ 1,225,357.27	\$ 0.61	\$ 2,999,185.50	\$ 1.50	\$ 8,160,533.02	\$10,294,674.93	\$5.10	1918
	\$55,501,589.28		\$45,269,023.85	\$22.65				1919

(d) Includes depreciation of plants and equipment and all taxes, except Federal income and profit taxes, for which no reserves were set up in 1919.

the break in the copper market, and the resulting curtailment. When production was at the maximum during the War it was difficult to obtain experienced miners and it was considered better policy to concentrate energy on steam-shovel operations. I understand, however, that work is to be resumed at the Veteran. The area of oxidized contact ores in the Veteran ground is identical with the formation on the Giroux property of the Consolidated Copper Mines Co. where, near the Alpha shaft, 300,000 tons of 7% oxidized copper ore is proved in a single pipe between the 1000 and 1300-ft. levels. Diamond-drills have given favorable cores from points as low as the 1600-ft. level, thereby indicating immense possibilities. The Nevada Consolidated company is mining, from the lowest level of its Ruth mine, high-grade ore of a character entirely distinct from the porphyry ore. It seems entirely probable that more of these contact deposits will be developed in the Boston Ely, Giroux, and Veteran mines.

With respect to the question of a water-supply, it is significant that during the War as much as 350,000 tons of ore per month, and as much as 13,500 tons per day for days in succession, was milled. This compares with the original plan of concentrating 5000 tons daily. When operations were at their maximum 10 second-feet of water was supplied by Duck creek, and, in addition, during the winter, 9 second-feet was available for pumping from the McGill hot springs. The supply from Murray and Steptoe creeks together would have been inadequate to mill this large tonnage. Moreover, the isolated site of the milling and smelting plants at McGill, where the company owns all of the neighboring land, has been a great advantage to the management in establishing ideal industrial relations with employees and townspeople.

The merger was effectually blocked at that time, but an arrangement was made whereby the Cumberland-Ely company acquired a half-interest in the Nevada Northern Railway from Nevada Consolidated in exchange for 200,000 shares of its own stock, and the two mining com-

panies under a joint agreement, with the Guggenheims in undisputed control, started the construction of the reduction works at McGill, the work being done by a separate company known as the Steptoe Valley Mining & Smelting Co. Later, in August 1910, the Cumberland-Ely company was absorbed by the Nevada Consolidated and the need for separate ownership of the smelting and milling plants disappeared.

At about this time Messrs. Thompson and Gunn acquired the Georgetown ranch, together with the rights to the water in the Murray creek, from the Nevada Consolidated company. The purchase price was only \$105,000. Thompson and his associates organized the Ely Townsite Co., subdivided the ranch-lands into town-lots and spent \$800,000 in an endeavor to build up the town of East Ely about a mile east of the older settlement. This was resented by the people of Ely, who saw in it an attempt to depreciate the value of their own real estate. The Nevada Northern railroad-shops and general offices, and the principal station were built at East Ely; a hotel, store-buildings, and a lot of residences were built, and numerous public utilities were provided; but, in spite of several attempts at artificial booms in town-lots, East Ely never prospered.

W. N. McGill, the owner of the ranch, had been among the first operators of the Chainman mine, but his attention had been diverted from mining to stock-raising. He got an excellent price for his ranch and water-rights and retained several thousand head of cattle after his fertile acres had been converted into a tailing-pond. Today he is reputed to be one of the wealthy men of the State. He owns half-a-dozen large ranches in White Pine county and in addition has at East Ely one of the few independent packing-houses in the country. Here he kills cattle, sheep, and hogs to supply meat for the adjacent territory. It is said that the Nevada Northern protects his business by 'regulating' upward the freight-rates on eastern cold-storage meat. The town of McGill is named after the former owner of the ranch.

Pope Yeatman became consulting engineer, performing the duties of managing director, during the construction period, while Thomas W. Cox was in immediate charge of the design and erection of the plants until May 1907, when he was succeeded by S. S. Sorensen. The first ore was treated in May 1908. At that time the operating staff was composed of Capt. Toms, mine superintendent, Thomas W. Cox, general superintendent, and Joseph Gazzan, local manager. In June 1907, C. B. Lakenan was made general manager, Mr Yeatman retaining the position of consulting engineer. Mr. Lakenan has been manager ever since. During his administration the company has prospered. Mr. Lakenan is progressive; he is willing to try anything that offers a reasonable prospect for improvement. He also believes in giving the men under him plenty of opportunity to show what they can do. He is slow to interfere, preferring to judge from results, and as an executive evokes the loyalty and co-operation of the members of his staff.

There have been a number of changes in the less important positions. In 1910 E. E. Vanderhoff succeeded Gray as mine superintendent. Mr. Vanderhoff's specialty was open-cut mining, so that, when in 1914 Robert Marsh Jr. became general mine superintendent, he remained as superintendent of steam-shovel operations. In 1915 W. S. Larsh took charge of the underground work at the Ruth mine under Marsh. Larsh is still there as superintendent of the Ruth, while F. E. Grant is superintendent of steam-shovel mines. The position of general mine superintendent has been abolished and Messrs. Grant and Larsh co-operate remarkably well in directing such work as necessarily must concern the responsibilities of both. During a short intermediate period Mr. Sorensen was in charge of the mill in succession to George F. Waddell, but in February 1915 George C. Riser, then at the Magna plant of the Utah Copper Co., was made superintendent, a position he still holds. Mr. Sorensen was smelter superintendent from March 1909 until August 1914 when he left to become manager for the Braden Copper Co. at Rancagua, Chile. He was succeeded by R. E. H. Pomeroy. In June 1920 Pomeroy resigned and his assistant, J. C. Kinnear, is now superintendent. In 1915 the control of the company passed to the Hayden-Stone and Jackling interests, D. C. Jackling becoming the dominant figure in the management, although Mr. Yeatman's connection as consulting engineer did not terminate until January 1916.

The first ore milled came from the Eureka pit on Copper Flat and during the first years the steam-shovel operation supplied nearly all of the ore treated. The orebody in the Ruth mine is overlain by from 125 to 450 ft. of cap-rock, so that a caving method of mining was necessary. J. Parke Channing proposed a 'top-slice' caving system similar to that used in many Lake Superior hematite mines; Henry Krumb suggested either 'top-slice' or a 'room-and-pillar' caving. The present method known as the 'branch-raise caving system' is a development of shrinkage-stope mining like that used successfully at Ray, Arizona, which was tried at first but was gradually

displaced during 1915 and 1916.

At the outset the mill had eight identical sections, the equipment consisting of rolls, Richards vortex classifiers, Wilfley tables, Huntington and Chilean mills for re-grinding middlings, and vanners with both smooth and corrugated belts for concentrating slime. Callow cones were used for de-watering the table-feed and several Callow screens sized the finer products. The smelter, built just north of the mill, presented no novel features. The concentrate was roasted in 16 McDougall furnaces, the calcine from which was carried in closed cars to five reverberatories. Reverberatory slag was skimmed and granulated in water. The molten matte was carried to the converters. Between 68 and 70% of the copper in the ore was recovered as blister.

In Mr. Requa's article in the 'Mining and Scientific Press' of November 3, 1906, before the Cumberland-Ely episode, he said, "It would be the height of folly to say that the methods of handling these ores have been perfected. We are today confronted at the first step of our process with a loss of from 15 to 20%, which is carried away in the tailing from our concentrators. I know of no field so promising for the winning of a large fortune as the perfecting of some method whereby the loss in concentration may be eliminated, or at least largely reduced. The smelting processes are much nearer perfection, but, with all that, it is safe to say that the plant which we are going to erect for the treatment of these ores will, within ten years, be obsolete. In fact, I believe that we shall, within five years, see changes that will materially alter our process in some of its most vital points. We are, however, building here at this time the very best plant that the combined knowledge of modern copper metallurgy is capable of producing, and I can say without fear of contradiction that, when finished and in operation, it will be the most modern and economical copper-reduction plant in the world."

As a matter of fact, the concentrator lost from 25 to 30% of the copper. This must not be construed as indicating that the tests made at the small mill at Ruth by Fleming were in great error for the reason that Fleming used ore from the underground workings, which was more amenable to concentration than that from steam-shovel operations, and the pits supplied most of the ores for the operations at McGill. However, Requa spoke prophetically. Within a year after starting, changes were made that increased the capacity of the milling-plant by 50% and since then alterations and remodeling have been going on almost constantly. Flotation, of course, has been the reason for the more recent changes; today the newest unit contains practically nothing that was included in the original design. Even the fine-ore bins and feeders have been re-built.

In subsequent articles I shall review briefly the progress made in mining and metallurgical processes, and give in some detail a description of the methods now being successfully used. The accompanying tables gives in statistical form sundry data regarding production, costs, and ore-reserves during the years 1909 to 1920 inclusive.

Are Drill-Bits Magnetic?

[The following correspondence explains itself.—
EDITOR.]

January 24, 1921.

R. H. Handy, Mill Superintendent,
Bunker Hill & Sullivan Mining & Concentrating Co.,
Kellogg, Idaho.

Dear Sir:

We have read Mr. T. A. Rickard's article in the 'Mining and Scientific Press', the January 8th issue, page 48, his statements regarding the use of magnets to protect machinery against tramp iron and steel, and his statement that miner's drill-points are non-magnetic.

We would like to inquire what is the composition of this steel, as in our experience we have found that this steel is generally made of high-carbon steel corresponding to tool-steel. Certain rare metals are added occasionally to increase the toughness, such as vanadium, nickel, etc. We have always found this material magnetic and consequently are very much interested to receive if possible a sample of this steel. We would like to experiment with it upon one of our magnetic pulleys here in the factory and also see its relative permeability.

We have had some difficulties with manganese steel, in fact several years ago the Chile Copper Company, while using manganese-steel dipper-points upon their steam-shovels. This steel is non-magnetic and we ourselves use a special-alloy manganese-steel for chutes and similar construction around our magnetic machines.

Trusting it will be convenient for you to submit a sample of this material, and assuring you of our extreme interest in this matter, we are,

Yours very truly,

DINGS MAGNETIC SEPARATOR CO.

Kellogg, Idaho, February 8, 1921.

Mr. P. R. Hines,
Care Dings Magnetic Separator Co.,
Milwaukee, Wisconsin.
Dear Sir:

I am sorry to have been so long answering your letter of January 24th concerning drill bits. I was away when your letter came and have been exceedingly busy since returning.

It is unfortunate that we allowed Mr. Rickard to get the impression that the bits were *non-magnetic*. What we believe they are is less magnetic than other forms of steel. A few years ago, when we replaced the rolls in our crushing plants with a Symons disc-crusher, we had lots of trouble with drill-bits getting into the machine. These bits passed a 36-in. electro magnet which was consistently catching hammer-heads, drill-shanks, track-spikes, nails, etc., out of the same ore-stream which carried the bits. If there was any of the shank with the bit the large magnet caught it, but what we almost invariably found in the crusher was the bit alone. We placed a 24-in. magnet just before the Symons crusher where the magnet could hang within a couple of inches of the ore-stream and we have had no trouble since. These cir-

cumstances are what led to the rather loose statement that the bits were non-magnetic. I don't think our drill-bits are any different than those in use at other plants, but we are under the impression that the treatment and tempering of the steel tends to destroy its magnetic qualities somewhat.

If after reading this explanation, you still desire a sample of the drill-bits in question, I will be glad to send you some.

Yours very truly,

R. H. HANDY, Mill Supt.

Deep Mining on the Rand

The following is quoted from the recent presidential address of James Whitehouse before the South African Institution of Engineers. He was speaking of the difficulties experienced as the mines become deeper.

The rock-temperatures continue to rise at the rate of 1° for every 253.9 ft. of depth. From determinations made recently in the Village Deep mine, the rock-temperature at a depth of 5487 ft. has been found to be 89.4° F. The temperature of the air current which reaches to this depth is 72.6° F., dry bulb, and 71.6 wet bulb. This low rise of rock-temperature is probably unique, and compares favorably with the temperatures experienced in the St. John del Rey mine, which is the only mine in the world which is deeper than the Village Deep, and where the air-temperature is 109° F. dry bulb, and the rock-temperature is 114.4°. The depth of this mine is 6126 ft. vertically. At depths between 5000 and 6000 ft. it is necessary to install equipment for circulating large volumes of air.

While the effect of depth on the temperature of underground workings is less serious at the Village Deep mine than, perhaps, in any mining field, this cannot be said of the resulting pressure, and the difficulty which this causes in deep workings. From a comparison of the actual cost of support of the workings on a deep-level mine today and in 1914, it is found that the cost of timbering and rock-walling in 1914 was 10d. per ton crushed, and in 1919 this charge had increased to 2s. 5.4d. On the basis of wages paid in 1914 and the cost of raw material at that time, the cost for this work in 1919 would have been 1s. 9.6d. per ton, that is an increase equal to more than double the 1914 cost. This represents the increase which is entirely due to depth, the difference between the present cost is 1s. 9.6d. per ton, which is 7.8d. per ton, being due to the increase in wages and cost of materials. Similarly the cost of winding has risen from 1s. 8.6d. in 1914 to 2s. 9.7d. for 1919, of which increase 8.5d. is due to depth, so that the cost for this work, apart from charges due to the War, would today have been 2s. 5.1d. per ton. From the above figures, and, quite apart from the increase in operating costs due to the War, the conditions obtaining in deep mines today differ from those of 1914. It has been suggested that, to save hoist costs, reduction plants should be operated underground!

Treatment of Mine-Timbers

Geological conditions in the anthracite coalfields necessitate the use of large amounts of timber underground. Several factors tend to shorten the life of this timber: there is a constant stress, and at times the squeezing action or subsidence is so great that many of the supports are crushed or broken beyond repair. The damp warm atmosphere in many parts of the mine leads to fungoid growths, rotting, and decay.

The average life of such timber is about three years. Not only is the initial cost a high one, but an additional expense is incurred by the necessity for the frequent replacement of broken or decayed timber. This labor cost amounts to approximately one-half the cost of the new untreated timber. There are places in the mine that may be abandoned while the timber is still serviceable; but timber used in the main haulage and air-ways must be in service for practically the entire life of the mine. For this reason, any method or treatment that will prevent decay and thereby prolong life will result in a considerable saving. Care should be exercised, however, in placing treated timber only in those parts of the mine where crushing or squeezing is least likely to occur; because no treatment would prove economical if timber is broken after having been in use for a short time only. The factor of breakage, of course, may not be so serious in other mining districts as it seems to be in the anthracite region.

During the years 1906, 1907, and 1908, the Philadelphia & Reading Coal & Iron Co. conducted experiments to determine the relative value of creosote, gas-tar oil, and zinc chloride; all of which were used in the open-tank method. It was therefore necessary to air-dry or season the timber for a period of 60 to 90 days in order to secure the desired impregnation. This experimental work demonstrated the value of the treatment, and a small pressure plant was accordingly erected at the Silver Creek colliery, at New Philadelphia. With this it was possible to treat the timber more economically as well as more efficiently. For a short time, creosote and gas-tar oil were used with good results, but because of the possibility of fire underground it was decided that the presence of any kind of oil would increase the risk to danger point.

Beginning with 1908, zinc chloride was used by injecting half a pound of the salt, in a 4% solution, per cubic foot, into the timber; and this practice was continued until the latter part of 1915, when it became increasingly difficult to purchase an adequate supply at a reasonable price. Upon the advice of the company's chemist, sodium fluoride was tried, being readily obtainable in powdered form. It is sparingly soluble in water, and a 3% solution was used at first. The salt can now be purchased from a number of firms, but there is little information available as to just what degree of purity is desirable; it usually contains from 78 to 90% of sodium fluoride. The impurities present are sodium silico-fluoride, or sodium fluo-silicate, sodium sulphate, and insoluble matter such

as silica or clay. The advantages or disadvantages of these impurities are open to discussion.

The specification made by the Philadelphia & Reading company's chemist was: "The material should contain at least 94% actual sodium fluoride, other salts not to exceed 0.5%, matter insoluble in water not to exceed 0.5%, and sodium carbonate, not over 1%. The material should be free from acid and should contain as little water as possible."

During the past two years, because of war conditions and attending difficulties in procuring both a regular supply of timber and preservatives, very little investigation work has been done, but the company is now accumulating a large stock of suitable timber which will be treated with sodium fluoride in the near future.

Several hundred sets of the timber treated with coal-tar creosote during 1907 and 1908 were placed in a gangway, which later was closed because of conditions arising in the mine. Other sets so treated show an increased life of 10 years. The sets treated with water-gas coal-tar have also shown resistance to decay, but the results are not equal to those obtained by the use of creosote. The timber treated with sodium fluoride (0.3 lb. of salt per cubic foot) and which has been in the mines for five years, is still in good condition. Timber treated with zinc chloride (0.5 lb. of the salt per cubic foot) has been in use for 10 years and is still in serviceable condition. Both of the methods described result in a considerable increase of life as compared with untreated timber and at an added cost of about 25 to 30%. The experimental timbers treated with the various preservatives amount to a total of several thousand sets; and results have conclusively proved that it is possible to increase greatly the life of the timber by the adoption of such methods.

THE mineral resources of Siam, according to a consular report, include rubies, sapphires, gold, copper, coal, iron, lead, zinc, antimony, molybdenum, tin, and wolfram, of which tin and wolfram are being worked on a commercial scale. The tin output for the fiscal year ended March 31, 1919, amounted to 148,425 piculs (1 picul = 133½ lb.), compared with 153,782 piculs for the corresponding period of 1917-'18. About one-half of this tin was recovered by dredging. The Siamese Tin Syndicate reported a profit of £34,159 for last year, compared with £35,652 in the preceding year, and the dividend at 25% was maintained.

THE manufacture of plastic magnesite for flooring and stucco work has recently been engaging special attention. It is prepared, says the 'Technical Review', by a process somewhat akin to refractory magnesite, except that in the furnaces it is not brought to the same high degree of heat as the refractory article, and the burning is done with closely controlled temperature. After burning, the lumps are ground to 200 mesh, the same fineness as is required for cement. It is stated to resist heavy vibration, to be unaffected by water or heat, and not to contract or expand under any climatic conditions.

REVIEW OF MINING

MINERALS SEPARATION STARTS SUIT AGAINST J. M. CALLOW

John M. Callow and the General Engineering Co. of Salt Lake City are accused of infringement of patent in a suit filed recently in the United States district court by the Minerals Separation, Limited, of London, and the Minerals Separation North American Corporation. An accounting of the profits received by the firm through installing a pneumatic flotation process on which the plaintiffs claim to have patent rights, and a restraining order to prevent the defendants from further alleged infringement, are asked in the complaint. It is set forth in the complaint that the process in question was invented in 1905 by Henry Livingstone Sulman, Hugh Fitzalis Kirkpatrick-Picard, and John Ballot, all of London, and that the inventors secured a patent in the United States on May 29, 1905. The patent, with exclusive rights for the manufacture and sale of the process, was later transferred to the Minerals Separation, Limited, and the Minerals Separation North American, according to the complaint.

AUSTRALIAN STEELWORKS CLOSED BY STRIKES

A cablegram from A. W. Ferrin, trade commissioner at Melbourne, reports that the New Castle steelworks of the Broken Hill Proprietary Co., which employs about 5000 men, has been closed on account of the strikes at the mines of the company. During the year ending May 31, 1920, the company produced 296,000 tons of pig-iron from two furnaces having a capacity of 1000 tons daily. An additional furnace of 500 tons daily capacity has since been added, and preparations are under way for the installation of a fourth blast-furnace capable of dealing with 100 tons of steel every three hours. The lead and zinc mines of the Broken Hill company recently resumed operation after a shut-down of 18 months on account of a strike.

PROSPECTING THE ESQUIMALT & NANAIMO LAND-GRANT ON VANCOUVER ISLAND

In reply to an inquiry as to what steps the Government was taking with regard to mineral rights on the Esquimalt & Nanaimo land-grant—a large strip of land granted by the Dominion government in consideration of the construction of the Esquimalt & Nanaimo railway—the Minister of Mines presented correspondence between himself and the president of the C. P. R., of which the E. & N. Ry. is a subsidiary company. This strip of land has remained unexplored for a number of years, and it has been conceded generally by mining men that the railway company either should explore it itself or allow prospectors to do so. The following extract from one of the letters written by E. W. Beatty, president of the C. P. R., is of interest: "We are advised by persons competent to judge that in all probability there are valuable deposits of minerals in the land-grant. The properties already being worked by the Consolidated company, such as the Sunloch, are evidence of this fact. In the circumstances naturally the company desires to acquire as much knowledge as possible of the mineral values in these lands before concluding the pending negotiations, and with this end in view it is proposed, as early as possible, to do ex-

tensive exploratory work which will involve the expenditure of a large sum. We are arranging for the co-operation of the Consolidated company in this connection. I can assure you that the company is at one with the Government in its desire to see the mineral resources of the land-grant developed, and the negotiations can be continued when we have the data desired."

SUIT OF UTAH MINING COMPANIES AGAINST POWER COMPANY DECIDED ADVERSELY

A decision was rendered on February 25 by the Supreme Court of Utah in the case in which sundry large corporations in the State, including the mining companies, sought to prevent the Utah Power & Light Co. from abrogating 'special contracts' for power furnished by the power company. The case was brought before the Public Utilities Commission nearly two years ago, and in October 1920 that Commission rendered a decision and order, compelling all holders of special contracts to accept power at schedule rates. The companies appealed the case to the Supreme Court, and the decision rendered on February 25 upheld the Public Utilities Commission, the Supreme Court holding that contracts made and entered into between public utilities corporations and private companies are subject to revision by the State Public Utilities Commission and the rates may be changed by that body, if after an investigation, it appears that the utilities corporation is not getting an adequate return for its service. Among the mining companies involved are the Utah Copper, United States Smelting & Refining, Silver King Coalition, Silver King Consolidated, Chief Consolidated, Eagle & Blue Bell, Daly West Mining, Bingham Mines, Judge Mining & Smelting, and Utah Metal & Tunnel companies. Since October 22, 1920, when the Public Utilities Commission order went into effect, the power bills of these companies have been increased from 25 to 50%.

ANACONDA COPPER'S OPERATIONS

Through its wire-mill the Anaconda Copper company has an outlet for practically all its current production of copper. Last year this department consumed close to 100,000,000 lb. and found a good market for its manufactured product. The company has greatly curtailed its activities in South America, where the Andes Copper Co. has stopped all but a small amount of development work. That property increased its ore-reserves during the past year materially. It will probably develop a tonnage about 50% greater than Inspiration with the grade of ore averaging about the same.

TAXATION OF MICHIGAN MINES

For the past two years the State Tax Commission has had three experts in the copper region investigating the value of mines, presumably for the purpose of applying the actual valuation basis to the copper mines, as is in effect in the iron-mining region. At present the mines are assessed according to the market price of the stock, the mean price for 52 Mondays of the year being taken as the basis on which the valuation is computed. In most instances there is no fault to be found with this system, and, in fact, the results

are about identical with the valuations put upon the mines in question by Federal engineers. On the other hand, some of the smaller mines, particularly non-producing properties, feel that they are shouldering a heavy burden under the present system and they would welcome a change. There is a bill before the legislature now to assess mines according to the value of buildings on the property and on the amount of ore mined during the year. This would be a radical departure over the present method. The outcome of this measure is being watched with interest.

MARKET FOR LEAD AND ZINC ORES IN JOPLIN DISTRICT

The market price for zinc-blende ores at Joplin remained fairly well fixed at \$22.50 during the week ended February 19, although there were efforts on the part of buyers to break the market at \$20. Because of this attempt the sale of zinc-blende ores, 800 tons, was the smallest of any week for a period of ten or fifteen years. Of this 800 tons, approximately half was secured for \$20 per ton, and the bulk of the ore so sold was sold in conjunction with lead ores in order to make sales. Ore producers were strong in their attitude in accepting no less than \$22.50, which pegged the market at that point.

There is a well defined buying movement on the part of merchants and speculators to take over any ore available at \$22.50, with the idea of holding for a higher market level. It is reported that a large pool is being formed for the purchase of 10,000 tons of ore at \$22.50. Lead ores showed weakness and lost \$5 per ton from the previous week's market. This brings the base price for 80% lead down to \$40. It is noticeable, however, that the buyers of lead ore are taking all that can be secured at this price.

ARIZONA

Bisbee.—The work of sinking the Campbell shaft of the C. & A. Co. below the 1400-ft. level has been resumed. The shaft has four full-sized compartments, and is concreted from the surface to the 700-ft. point. With 16 ft. of further sinking the Junction shaft will have reached the 2375-ft. point. A station will be cut on the 1900-ft. level, a station and a skip-chute on the 2000-ft. level, a station on the 2100-ft., a station, a skip-chute, and a pump-room on the 2200-ft. level, and a small station on the 2300-ft. level. The carbonate orebody that was entered several weeks ago on the 700-ft. level, 480 ft. north-west from the Junction shaft, has been followed for 71 ft., the ore averaging 19% copper. This carbonate ore is being shipped to the smelter along with the sulphide.

The annual report of the Employees' Benefit Association of the Copper Queen company shows an income of \$82,172; death benefits paid, \$17,636; accident benefits paid, \$11,150; sick benefits paid, \$34,830; administration expenses, \$4871; leaving a surplus for the year of \$13,677. Since its organization in 1910 the Association has paid benefits totaling \$656,322. Accidents that occur on duty with a disability under 14 days duration and those that occur off duty with benefits accruing for one year if disabled, together with sickness benefits, and death benefits, are provided for. That the association stands high in the estimation of the employees is evidenced by the following proportion of membership based on the average working force: Bisbee, 84.5%; Douglas, 70%.

Globe.—The Old Dominion Co. has recently entered a rich body of ore at the 1600-ft. level. It extends eastward 1300 ft. to the property of the Arizona Commercial Co. The cross-cut indicates the width of the vein to be 40 ft. with an average content of 6% copper. The reduction in the flow of water from the mine has reduced costs. At the pres-

ent time 3,400,000 gal. of water is pumped each 24 hours. The fire that had been burning in the pump-shaft has finally been extinguished. The fire damaged the shaft from the 14th to the 18th level, and so intense was the heat that the air column was melted and the lower levels were flooded. The smelter lost only one day as a result of the curtailed output.

Jerome.—The United Verde Extension Co. produced copper during 1920 at a cost of \$53c per pound, exclusive of depreciation and depletion. In spite of this, however, the net loss to surplus was \$819,208. The annual report says that general conditions are satisfactory with the exception of increased cost for coal and coke at the mine, and increased freight-rates on supplies purchased and copper shipped. The amount of ore developed and remaining in the mine above the 1500-ft. level is estimated at 1,148,800 tons, averaging 11.8% copper, 0.023 oz. gold, and 2.22 oz. silver. The cost per pound of copper produced is divided as follows:

Mining	\$0.0343
Smelting	0.0215
Freight on ore.....	0.0010
Freight on bullion and refining.....	0.0274
Other expenses	0.0011
	<hr/>
	\$0.0853

CALIFORNIA

Engels.—The annual report of the Engels Copper Co. shows an operating profit of \$88,055; and after deducting for depreciation, a net balance of \$59,654 was credited to profit and loss account. During the year, 8,571,000 lb. of copper, 119,165 oz. of silver, and 12,017 oz. of gold, with a gross value of \$1,620,525, was produced. The cost per pound of copper, after crediting the gold and silver, was 16.67c. per pound.

During the year the ore-reserves were greatly increased in both the Engels and Superior mines, there now being over 3,000,000 tons available. Production increased 33½% within the past three or four months since labor became more plentiful and efficient. The mill is now taking about 800 tons per day, but within the next six or eight months the output will be increased to 1200 or 1500 tons per day. During the past year the development work on the lower levels of both mines was exceedingly satisfactory, disclosing higher-grade ore than in the upper workings.

Jackson.—The Elephant hydraulic mine, near Volcano, is operating a number of plants under a 250-ft. head. Fifty sluices are being supplied, with excellent recovery reported. The H. L. Crocker company of San Francisco owns the mine.—Edward Higgins reports that the repairs on the mill of the Fremont Consolidated Co. are 90% complete. The unwatering of the Fremont and Gover shafts has been completed, and mining will be started shortly.

At the Argonaut mine unwatering has reached the point below the 4050-ft. level, on which the Argonaut and Kennedy mines are connected. The use of the underground hoisting equipment on the 3900-ft. level is to be discontinued. No definite announcement is forthcoming as to the plans of the Kennedy company, but the Argonaut expects to mine from the lowest levels.

Johnsville.—The owners of the Plumas-Eureka mine have made preparations for resuming operations. Drifts and raises have been driven to connect the main haulage-ways, thereby avoiding the use of the aerial tramway. The mine was first worked in 1857, and is credited with a production of \$25,000,000 in gold.

Oroville.—The Square Deal Mining Co. has completed a 100-ton mill at its gravel mine near Bangor. The property is situated on the Blue Lead channel, which has been opened by a 60-ft. shaft and a 300-ft. adit.

Redding.—Following a visit of G. W. Heintz, vice-president of the U. S. Smelting, Refining & Mining Co., to Kennett, orders were given to shut-down development work in the Keystone mine, laying off 20 men. Fifty men are still at work on development in the Mammoth mine, but the duration of their employment is uncertain. The smelter at Kennett has been idle since May 1919.—William Erwin of Oakland has taken a bond and lease on the Milkmaid mine near French Gulch and set a crew of four men to work.

Ubechebe.—The fourth carload of lead-silver ore has been shipped from the stope on the 80-ft. level of the Arrowhead Rico and seven more carloads are broken at this depth. The lower tunnel, being driven to the vein, has cut a seam of ore of the same grade as that in the upper tunnel. Four trucks are hauling 50 miles to the railroad.

COLORADO

Central City.—Operations are shortly to be resumed on the East Notaway. Work for the present will be confined to the 600-ft. level, as water stands in the mine workings to a point above the 750-ft. level station.—Three shifts are employed sinking the Atlantic shaft at Hughesville and good progress is reported with the 100-ft. lift.—The Midland company has unwatered the shaft on the Alaska to the 250-ft. point. Miners are working on the 160-ft. level.

Cripple Creek.—Stockholders of the Dig Gold Mining Co., owning the Alpha and Omega on the southern slope of Gold Hill adjoining the Caledonia mine, have formed a leasing syndicate, secured a five-year lease, and will continue development started on company account. The syndicate, comprised of a majority of the Dig Gold stockholders, is extending the drift on the west vein northward and is nearing the junction of this vein with the southern extension of the rich Pointer or Keystone vein that produced high-grade ore on the Index properties.

Denver.—The Senate has passed the bill making lode-mining claims a uniform width of 300 ft. In Boulder, Clear Creek, Gilpin, and Summit counties claims are but 150 ft. wide.

M. B. Burke, well known Cripple Creek mine-operator, who secured the first 40-acre 'presidential' lease in the Salt Creek oilfield in Wyoming, has donated property, said to be worth approximately half a million dollars, to Denver charitable institutions. The 40 acres turned over is owned by the Pacific Oil Co., controlled in its entirety by Burke and wife. Leases now owned by Burke according to oil-men will make him many times a millionaire. In Cripple Creek Burke opened rich ore on the Henry Adney, Beacon hill. He sold the property two or three times, receiving a large initial payment. The purchasers failed to meet their obligations and the property necessarily reverted to Burke, who would open new ore and sell again.

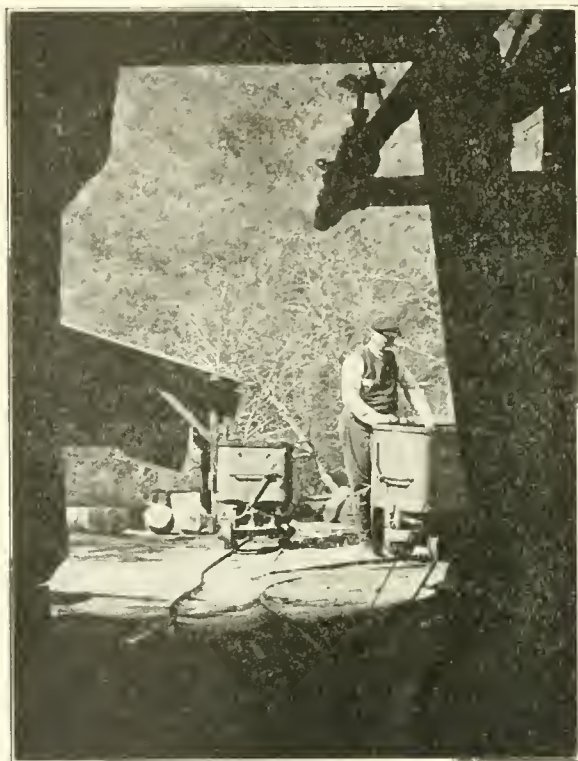
Dumont.—The Blue Ridge Mining Co., operating in and around Dumont, is shipping high-grade ore direct to the smelter; the mill-ore is being handled at the old Hoosac mill, which is owned by the company and has recently been remodeled. Development work is being done at the Senator, one of the company's largest producers, one drift and four raises being under way at present.

The Amherst Mining Co., operating the Hampton properties in lower Russell gulch, is reported to have suspended operations for a short period. New pumping equipment is to be installed and the shaft sunk an additional 200 feet.

Hot Sulphur Springs.—Construction work starts March 1 on the first 100-ton unit of a 500-ton electrolytic plant by the Electro Copper Co. on its property on Harmony creek, 44 miles from Hot Sulphur Springs in Eagle and Routt counties. Copper ore in blanket formation averaging 9% with low silver-gold content has been opened in different workings on the 160 acres and a large tonnage is mined

ready for treatment. H. V. Rathbun of Denver will be in charge of operations as manager. Millmen and miners have been engaged to report for duty March 1. Machinery and equipment have been purchased and a camp established. The Moffat railroad traverses the property.

Idaho Springs.—The Gem Mining Co., that recently purchased the Newhouse tunnel and Argo mill, plans an expenditure of approximately a quarter of a million dollars within the next few months in re-construction and equipment of the Argo mill to treat 200 tons per day, and in development of its Clear Creek properties.—A reduction of more than 50% in freight-rates in the Newhouse tunnel has been put in effect, and has resulted in renewed activity in both the Idaho Springs and Central City districts traversed by the tunnel. High-grade gold, silver, and galena ore is already being mined by the Gem company and the cost of



Portal of Tunnel No. 3, Green Horn Mountain Mine, Shasta County, California

operating, including mill treatment, is estimated to not exceed \$5 per ton, thus making the mining of \$10 grade ore profitable. From the Lost Mazda vein, gold-silver-lead ore sampling better than \$30 per ton has been found between the 1600 and 1400-ft. levels, and the ore is being saved for shipment.—The Ophir, Concrete, and the Golden Edge companies are operating in the Argo tunnel in addition to the Gem company.—A company of Denver capitalists has re-opened the Black Eagle workings in the Mattie district. Harry Short, who is in charge, states that the property will be worked through the Star tunnel. The Black Eagle is well known here as one of the old producers.

Silverton.—Rich silver ore has been found by A. M. Barnes on the John Perrung property, where he has a lease. At a point 700 ft. from the portal of the tunnel, Barnes exposed four feet of ore containing galena, gray copper, and ruby silver. A side-track of the Silverton Northern railroad is situated conveniently.—The United States Mining Corporation is developing a wide vein of good ore on the Toltec group of claims. The metals are silver and lead, with some copper. A raise from the 1310-ft. level is up 100 ft. still in ore.

IDAHO

Idaho.—Arthur A. Diegel is the discoverer of what promises to be a valuable deposit of uranium ore in an old volcano crater. An assayer's certificate shows an average assay of 1.15% uranium oxide from a number of samples. The depth of the deposit is still undetermined, but development work is progressing.

Coeur d'Alene.—The Hecla Mining Co. has declared a dividend of 15c per share, payable March 28, and totalling \$150,000. This is the regular quarterly dividend, which has been paid in like amount for the last two years except in July 1920, when it amounted to 20c. Including the dividend just announced, the Hecla has paid \$8,655,000 to its stockholders. Last year's dividends amounted to \$650,000. —The Morning mine of the Federal Mining & Smelting Co. is working three shifts and employing 350 men underground and in the mill. The mill is treating 1500 tons daily and the shipments of smelting ore are averaging two cars per day. The higher-grade ore is said to be richer in silver than any ever taken from the property and the milling ore is also higher grade than formerly.

The Idaho Mines Leasing Co., now working above the old No. 2 tunnel of the Black Bear in property owned by the Federal company, has uncovered sufficient ore to keep its 50-ton mill running for three years. In the stopes that have been opened in the upper workings, a fine body of silver-lead ore, containing little zinc, has been developed. It is said that the ore-shoot has been opened up for a length of 400 ft. —More than a carload of high-grade silver-lead ore has been taken recently from the old No. 2 tunnel of the Mammoth mine near Mace. Considerable work was necessary to clear out the old workings and re-timber before mining started. Some of the ore assayed as much as 100 oz. silver per ton.

Lessees on the Three Sisters mine, east of Wallace, will ship their third car of high-grade ore to the Bunker Hill smelter in a few days. The ore is coming from the lower tunnel of the property at a point about 600 ft. from the portal. Assay reports show 35% lead and about the same number of ounces of silver per ton. Besides the lead and silver, it is said that the ore contains considerable zinc, but no effort is being made to save the zinc on account of the low market price. —A body of gold ore has been developed recently in the Giant Ledge property near Murray. The Giant Ledge is controlled by W. W. Johnston, of Spokane. —Articles of incorporation for the Slate Creek Mining Co., a new corporation taking over the holdings of the old Franklin Security Co., on Slate creek, 12 miles south of Wallace, have been filed. The property includes a group of claims upon which development work in the past has opened up a promising vein of silver-lead ore.

Salmon.—Earl F. Nieman, superintendent for the Harmony Mines Co., states the flow-sheet of the mill is being readjusted with the object of increasing capacity and improving extraction. With the addition of flotation equipment an extraction of 85% of the contained copper is expected, and by installing additional grinding machinery a daily capacity of 175 tons should be possible. The ore-reserves are said to approximate 200,000 tons.

R. H. Bradford, metallurgist for the Pope-Shenon company, states that the last shipment of material to complete the construction of the fusion-furnaces for the reduction plant has arrived here. The construction will be completed within a month.

MICHIGAN

Calumet.—Calumet & Hecla continues to move some copper. It has just completed a shipment of 250,000 lb. to Detroit and a shipment of 225,000 lb. for export to France. The company is now cleaned up on current foreign orders, but has an order for 450,000 lb. for export in March. Less

than half of its present metal production is being sold and even on the curtailed basis the surplus is steadily increasing.

Copper Range metal sales continue fairly good, but the February total likely will fall short of that for January, when 1,700,000 lb. was sold. January sales, which included considerable export copper, kept pace with production. Quincy is disposing of considerable copper to domestic consumers, but little if any for foreign account. The Dollar Hay wire plant is operating almost entirely on Quincy copper.

Copper Range continues to take on more men at its three mines, particularly at Champion, where more men are reporting for work than at either Battle or Trimountain. The enlarged underground force at Champion is reflected in a 20% increase in the rate of production over that of January. Production, however, is still far from normal. Champion is now hoisting nearly 2000 tons of 'rock' daily from its three shafts. There has been a slight increase in Trimountain and Battle shipments, the former sending about 10,000 tons to mill monthly, and Battle about 18,000.

Seneca's drifts have not yet reached a distance from the shaft to make artificial ventilation necessary. When it becomes essential to ventilate the drifts, that can be done by forcing air into them. A series of experiments in which the U. S. Bureau of Mines is interested is now being conducted at Mohawk. Ventilation methods and air-pressure in levels, drifts, and stopes are being studied. In testing the air-pressure the engineers are submitting to blood-pressure tests. Temperature of the body is being taken at various mine elevations as well as the temperature of various underground openings. It is believed the conclusions arrived at will be of interest to the mining industry generally.

Mohawk plans to resume sinking in No. 1 shaft about March 10. By that time it is believed the underground force will be large enough to warrant a start. Drifting from No. 4 toward No. 1 is progressing on the three bottom levels, the 23rd, 24th, and 25th. No. 1 shaft promises to be most productive when it is connected with No. 4. Much old and new ground remains to be worked and this shaft will contribute to an increase in production. Drifting and stoping are under way in No. 4, 5, and 6 shafts, with the total tonnage 2600 tons per day.

MISSOURI

Joplin.—A deposit of lead ore, 75 ft. wide and 20 ft. high, has been opened in the Dime mine near Spurgeon by the F. U. Tatman Mining Co. The company acquired the property in January, following the discovery of good ore in an abandoned well. Drill-holes have partly demonstrated the size of the deposit. Chunks of lead weighing from 300 to 400 lb. have been removed from one of the two drifts, which up to date have been driven back about 75 ft. from the shaft. The mineral is being handled by two hand-jigs at the present time while a mill-site is being drilled out. Tatman plans to build a 100-ton mill.

MONTANA

Butte.—The driving of the new air-shaft in the Colorado mine of the Davis-Daly company is progressing, about 400 ft. remaining to be raised. With the completion of this shaft, the main shaft will be made downcast. Production of high-grade zinc-silver ore, averaging 23 oz. silver per ton, from the company's Hibernia mine, materially offsets the loss in operating the Colorado. The shaft is down to the 600-ft. level and cross-cutting on this level has exposed a vein 2½ ft. wide, assaying 65 oz. in silver.

Great Falls.—The electrolytic zinc-plant of the Anaconda company closed on the last day of February. The mines were shut-down some time ago, so that recent operations were on stocks of zinc ore.

Deer Lodge.—The Butte Jardine mine and mill are operating with a daily capacity of 200 tons.

Dillon.—Work will be resumed at the Silver Spray mine, 21 miles south-east of here. L. D. Lyons has recommended that an adit be driven to develop the ground heretofore prospected through an 80-ft. shaft. Several good veins were cut.

Elkhorn.—More than \$4,000,000 has been expended by the Boston & Montana Development Co. in developing its Elkhorn properties, according to figures recently made public. The new 750-ton mill has been completed at a cost of \$500,000. The plant covers an area of two acres and is modern in every respect. A power and transmission line from the Montana Power circuit has been constructed at a cost of \$100,000. A railroad from the main line to the property has been completed at a cost of more than \$1,000,000. The railroad is now in operation. The tonnage of ore ready for treatment at the mill amounts to 1,000,000 tons, with an estimated 1,000,000 tons partly developed. Four of the known veins have been explored and the average assay of the ore is 5½ oz. silver, 2% copper, 5% lead, and 60c. gold. Basing the product of the mill upon normal prices the annual output is rated at approximately \$4,420,000.

NEVADA

Austin.—Three carloads of ochre was shipped recently to San Francisco from the Rast mine.

Goldfield.—The orebody on the 500-ft. level of the Cracker Jack lease on the Florence has been opened for a length of 40 ft. and for 20 ft. on the dip of the vein, according to R. C. McCarthy, superintendent of the Florence. McCarthy is of the opinion that the present workings will be the start of a stope from which a big production will be made. The length of the shoot has not been determined and the drift is being continued. This is the first important orebody found in the Florence since the opening of the Florence Divide orebody, from which \$192,600 was produced by the Florence Divide after Witt and Brandon had shipped from it several carloads of high-grade ore.

The Great Bend, in a raise from near the face of the intermediate level to the 236-ft. level, has opened an 18-in. width of ore assaying \$630 and \$980, with a 2½-in. seam assaying \$11,230. The raise was completed several weeks ago and the find was made in re-sampling it. The rich seam contains sylvanite, a telluride of gold and silver. The proportion of the metals in the \$11,000 assay was 1439 oz. silver and 489 oz. gold.

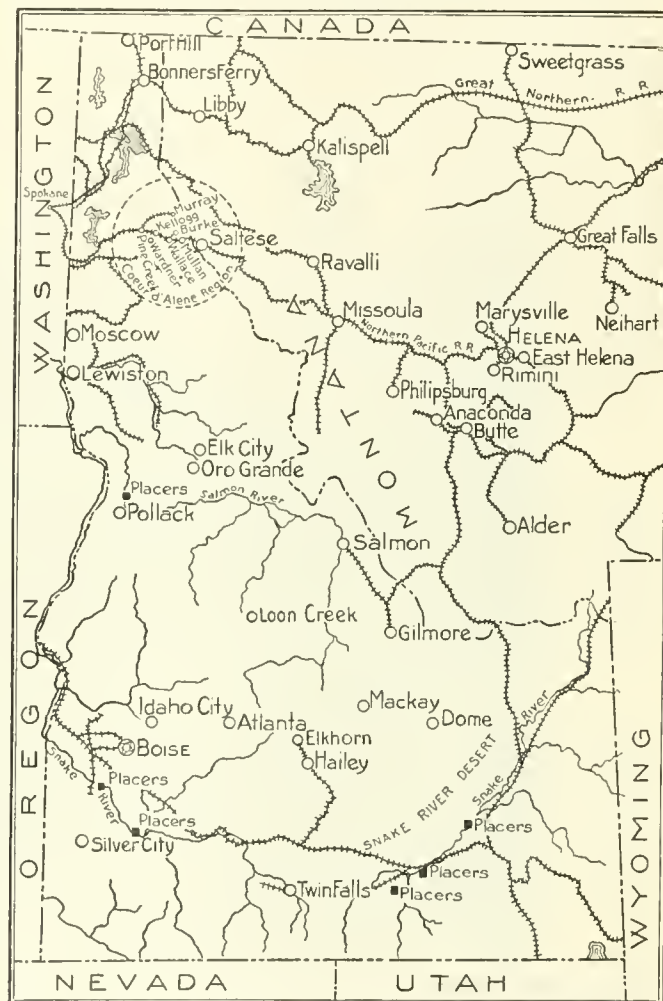
Hornsilver.—Work being done by J. W. Dunfee on the 580-ft., or bottom, level of the Orleans has exposed 6 ft. of ore. Whether the six feet represents a width or a length is not known. The ore assays \$20 in silver, according to Dunfee. This shoot is believed to be the extension of that from which Dunfee shipped heavily on the 400-ft. level. Working alone, he climbs to and from the shaft once or twice daily and the material that he breaks is put in old workings on the 580-ft. level.

Klondyke.—The Knox Divide has opened 4 ft. of \$70 ore in a drift driven east from the 30-ft. winze in the orebody that is being stoped on the 60-ft. level. The stope, which is about 60 ft. long and 7 to 11 ft. wide, has produced 450 tons of ore of an average value of \$24. Ore-chutes are being built at the winze and production has been started from it. Two air-drills are now in use.—The south drift in the foot-wall vein in the Maupin sub-lease on the Original Klondyke has been driven 40 ft. in a full face of ore that is expected to average \$40 when shipped in carload lots, the gold and silver content being equal.

Mina.—The Candelaria Silver Mines Co., a subsidiary of the International Nickel Co., will begin the construction of a 150-ton mill on April 1. Charles M. Kaeding, manager, has deferred construction in order to take advantage of the expected drop in the price of steel and building material. It

is said that 10,000 samples were taken in examining the extensive workings of the old mine.

Peavine.—The new vein, recently uncovered on the 300-ft. level on the Standard Metals mine, is said to have widened to 10 ft. The ore contains gold and copper. New equipment for the mill, including the largest size K & K flotation machine, has been purchased. A. L. Chappell is manager for the company.—A new shaft will be sunk on the Dawes group. Minneapolis capitalists are financing the company.—In the Fravel-Paymaster mine rich ore continues to show in the raises from the 200-ft. level, and shipment from the vein on this level to the Standard Metals mill is ex-



Map of Idaho

pected soon.—Sinking at the Black Panther is advancing steadily, with some excellent ore reported in sight.

Pioche.—W. E. Brody has shipped his first car of slag from the leased dumps of the old Pioche smelter. The American Smelting & Refining Co.'s Salt Lake Valley plants are the consignees.

Sinking of the Prince Consolidated company's shaft from the 900-ft. level is to be started immediately, according to an official announcement. This will be done for the purpose of exploring the quartzite underlying the limestone.

Pioneer.—The mill of the Consolidated Mayflower Mines Co. has been remodeled and is expected to start by March 10. Good ore is being developed, especially on the 200-ft. level south of the shaft.

Rawhide.—Reports from the Nevada Rand mine state that a drift on the 200-ft. level has followed ore for a distance of 60 ft. Sorted ore is worth more than \$500 per ton in shipping lots.

Rochester.—Frank Margrave, claiming to be the owner of 30,000 shares of stock in the Nevada Packard Mines Co., has filed a petition in the district court at Reno asking that the officers of the company be required to call a meeting of stockholders to elect a new board of directors. It is alleged that the directors, in violation of the by-laws, have decided not to hold an annual meeting in 1921 until the present litigation is ended.

Round Mountain.—Deep snow on the mountain ranges and new means for storing water make it probable that the coming season will be the best for placer mining in the history of the Round Mountain district.

Tonopah.—The Tonopah Extension, after making a connection between the McKane and Victor shafts, has resumed sinking the McKane shaft from the present depth of 1540 feet.

Virginia City.—A drift in the Hardy vein on the 2000-ft. level of the Ophir has been driven 40 ft. in a 6-ft. width of ore assaying \$30 to \$45. Thirty tons was shipped to the Mexican mill last week. This newly found orebody is in a heretofore unexplored part of the mine and for this reason more than ordinary importance is attached to it. Improvements at the Mexican mill, consisting principally of an additional filter, have been completed. The dredge at Gold Canyon is being lowered on a 34% grade by the construction of levees. The operation of the dredge continues to be slightly impeded by boulders, as many as 30 of which are lifted in some days.

NEW MEXICO

Santa Fe.—Three bills to provide for proper and adequate taxation of mines are now before the State Legislature for consideration. The last is to empower the State Tax Commission to assess mines, mineral lands, and improvements; the first is included in the new revenue code; the second provides for the adoption of the Arizona plan, whereby taxes are based on three times the net profits.

OKLAHOMA

Picher.—The mine operators have adopted a plan for selecting the most deserving and needy of the unemployed miners of the district. A free employment bureau has been established where applicants for work will give their qualifications and number of dependents. The closing of many mines and curtailing at others have worked considerable hardship on those who made their living from mining.

UTAH

Alta.—In spite of the fact that there is more snow in this camp at present than at any time during the past 20 years, five mines are making regular shipments and several smaller ones are doing development work. The five regular producers are the South Hecla, Columbus-Rexall, Emma Silver, Wasatch Mines, and Sells. These companies have 20 four-horse teams for hauling the ore to Wasatch, 8 miles distant, which is the terminal of the standard-gauge railway. The teams haul from 4 to 6 tons to the load. During January, the South Hecla shipped 900 tons.

Dugway.—W. A. Byers, secretary-treasurer for the Bay State Mining & Leasing Co., states that a 22-ft. shaft on the Hornsilver claim is bottomed in ore assaying 15% copper and 10 oz. in silver. On the Little Ford claim a 2-ft. vein of ore, averaging 26% lead and 30 oz. silver, has been opened.

Eureka.—Production of the mines of the Tintie district for the week ending February 25 totaled 178 carloads, as compared with 155 carloads during the preceding week. Mines and the number of carloads of ore produced by each follow: Tintie Standard, 57; Chief Consolidated, 41; Dragon, 19; Iron King, 17; Eagle & Blue Bell, 14; Iron Blossom, 11; Victoria, 8; Centennial Eureka, 3; Gemini, 3; Grand

Central, 3; Eureka Hill, 1; Mammoth, 1. Total, 178 carloads.

At a meeting of the directors of the Iron Blossom Consolidated Mining Co. on February 19, it was decided to reduce operating expenses to the minimum. The company will discontinue the use of the large electric hoist at the No. 1 workings, as a plan has been worked out whereby the ore can be hoisted by use of a smaller engine, installed on the 200-ft. level. Development work is being carried on steadily at the Crown Point property, under the direction of M. C. Roundy. Most of this work is on the 1000-ft. level.

The shaft being sunk at the Independence property in the eastern part of the district has passed the 250-ft. level, according to Alex Mattson, who is in charge of the development. The bottom of the shaft is in porphyry, and no change is expected until a depth of 400 or 500 ft. is reached. Nearby this property, the East Standard company is also sinking a shaft, which has reached a depth of 290 feet.

Moab.—The Buena Vista Copper Co., leasing the property of the Big Indian company, 40 miles south of here, is putting the concentrator in shape for operation.

Park City.—During the week ending February 19, the Judge companies shipped 920 tons of ore; Silver King Coalition, 490; Ontario, 390; and the Naildriver, 60; making a total of 1860 tons. The Judge smelter shipped 40 tons of premium spelter. Shipments from the Naildriver property were suspended for several weeks, owing to the deep snow.

Salt Lake City.—The Public Utilities Commission of Utah has decided that freight-rates on ore-shipments shall be based on the 'actual' rather than on the 'declared' value of ore. The Los Angeles & Salt Lake railway argued that the value could be obtained from the smelter. At the request of the shippers, three intermediate grades between \$25 and \$100 were established. Hitherto the same rate has applied to all ores valued between these amounts.

BRITISH COLUMBIA

Nelson.—The Florence Silver Mines, Ltd., proposes to place a steamer and barges on Kootenay lake to enable it to ship concentrate to the Great Northern railway, and thus render it independent of the C. P. R. in shipping to the Bunker Hill & Sullivan smelter, at Kellogg. Except for a certain amount of ground that has been leased, work at the mine has been suspended pending more satisfactory transportation conditions.

Princeton.—A deposit of celestite, assaying 25% strontium, has been discovered about three miles from here. The owners, W. H. and H. H. Thomas and W. Mickel, are exploring the deposit, and, if the mineral occurs in sufficient quantity, propose to mine it. This is believed to be the only known occurrence of the mineral in Canada west of Ontario. Frank Gorgan is developing an 8-ft. vein, said to assay \$35 per ton, at the Peerless group, near Nighthawk. Some 7000 ft. of driving has been done on the vein. Since the closing of the Nickel Plate mine, at Hedley, Tim Griffin has been exploring his property just outside of the town. He has uncovered a lode nearly 100 ft. wide, and a trial shipment is being prepared. A considerable sum will have to be spent on making trails before machinery can be taken to the property or ore taken from it.

Trail.—The ore-receipts for the first two weeks of February at the smelter totaled 16,440 tons, of which the Consolidated company's mines provided all but 369 tons. Despite the fact that practically no custom ore has been received since the beginning of the year, the shipments received up to the middle of February are nearly 8000 tons in excess of those received for the same period of last year. More ore is being shipped from the Rossland mines, and No. 3 copper furnace recently was blown-in.

Vancouver.—The Engineer mine, at Atlin, once again is in

the courts. The Engineer Mining Co., an Alaskan corporation, has made the Attorney-General co-plaintiff and is suing for the property on the ground that the company originally staked the claims in 1899, and that the late James Alexander re-staked them in 1907, registering them in other names. It is claimed that Alexander had acted as chairman for the Engineer company in 1899, and that, when he applied to the mining recorder for the claims in his own and his friends' names, he stated that the claims were unoccupied Crown lands, whereas, it is claimed by the plaintiff that \$40,000 worth of work had been done and there was considerable equipment on the ground.

CHILE

Santiago.—Water-power in the central provinces of Chile is to be put to use to generate electricity for Santiago, Val-

MEXICO

Durango.—Fourteen new mining properties were filed upon here during the month of February.—A prospect-shaft is being sunk on the Calencia mine by Alfred S. España.—Good gold and silver ore is being mined by R. Zapeda on the Consuelo group of six claims.

At the Santa Maria del Oro property Manuel Carbajal has applied for titles to six claims known as La Encantada group.—At Topia, P. C. Almeida has denounced 12 pertenencias forming the Hamburgo group for the W. Bartning Co. of Durango City.—La Providencia and La Regeneracion mines are showing up well with the development work which is being done.

Zacatecas.—The Piedra Azul mines, situated in the Cemoroso mountains, of the Concepcion del Oro district, are



Plants of the Braden Copper Co. in Chile

paraiso, and neighboring cities and towns. A company, capitalized at \$3,250,000, has been formed for the purpose and work already has been started on a hydro-electric plant on the Colorado river, near Santiago, where it is expected 18,000 hp. can be developed. The project is backed largely by Chilean capital. There is need for more power by both the Valparaiso and Santiago street railways and by mining and industrial enterprises. Until recently no water-power concessions in Chile were granted by the president of the republic for more than 35 years, but the latest concessions are said to be perpetual.

MANITOBA

Flin Flon.—The preliminary survey of the railroad from The Pas to Flin Flon is being made by the Provincial government. It is said that 18,000,000 tons of \$10 copper ore has already been proved at the Flin Flon mine.

Winnipeg.—A syndicate of local capitalists has subscribed \$100,000 for sinking a shaft on a group of claims in the Lac Du Bonnet district, where excellent prospects for copper-nickel ore are found.

being developed by W. M. Mathews and associates. The old workings are being cleaned out. The same operators have filed on the Tepeyac and La Condesa groups in the near vicinity. Gold and silver ore is being produced from the surface workings.—Genaro Borrego has applied for patents to a group of mines known as the San Francisco de Javier, in the Rayo mountains. The property comprises six mining claims or pertenencias that are good prospects.—Edward P. Palmer, one of the pioneer mining men of this State, has made application for titles to several groups of properties in the mountains of the San Bernabe ranch. The Orlando and Soledad groups both are producing high-grade silver and lead ores.—There is renewed activity in the Veta Grande district, where August Reimers has taken up some new claims under the name of La Oriental. Francisco Lopez has been employed to make official survey.

Rosario.—The Rosario Mining & Milling Co. is planning to construct a highway from Guadalupe Calvo to its mines Ignacio Enriquez, Governor of Chihuahua, has promised aid in the construction of the road.

ONTARIO

Porcupine.—The shortage of power continues to curtail production, but as soon as this difficulty is overcome by the break up of the winter every indication points to a great increase in output. Labor is plentiful and though the cost of material is still high there is a downward tendency. One highly encouraging factor is the noteworthy increase in the grade of the ore at depth as shown by recent development on the Dome, McIntyre, and Hollinger mines, the ore reserves on the latter averaging \$11.11 per ton, as against \$9.09 at the close of 1919. Interest in this field has been greatly stimulated and many new enterprises will be started in the spring.

The McIntyre is planning to increase its milling equipment by additions which will increase its present capacity of 500 tons daily to 900 tons or upward, which would give an annual gold production of about \$3,000,000. This step is justified by recent favorable development of the new orebody below the 1000-ft. level, believed to be the continuation of the No. 84 vein of the Hollinger. In addition to this the extent and quality of the No. 5 orebody is improving and it is being worked at a depth of nearly one-third of a mile.

The Blue Diamond coal mine in Alberta, owned by the McIntyre and the Temiskaming of Cobalt, is now operating on a profitable basis, the equipment having been increased and the plant electrified, the production of coal now averaging \$00 tons per day.

A syndicate including local and American capitalists is negotiating for the acquisition of the Porphyry Hill property in Deloro township about half a mile south from the Dome Mines.

West Shining Tree.—Preparations are being made for an active season in this camp, which has recently been visited by several parties of investors from New York and other American cities who have inspected the leading properties. Large quantities of supplies and machinery are being brought in.—Before sinking on the Evelyn vein several thousand feet of diamond-drilling will be done to prospect surface veins at depth.

Bourke's Siding.—A number of properties in this neighborhood will be worked during the coming season, the most important being the Murray-Mogridge on which development has opened up veins of a good width. Other properties which will be operated include the Golden Summit, Height of Land Syndicate, and Trapper.

Cobalt.—At the 3rd level on the Hudson Bay mine, a large tonnage of medium-grade ore is being opened in territory heretofore not explored. The extent of the area opens possibilities of the life of the mine being lengthened. On February 19, the Nipissing mine shipped 200,000 oz. of silver. This was the first bullion shipment since the closing days of December. A large quantity of the metal has been hoarded in the hope of higher prices. Mill-heads at the Bailey Silver Mines have been established at an average of about 19 oz. silver per ton. Steady shipments are being made to the company's own custom mill.

At a depth of 410 ft. on the Chambers-Ferland mine, a vein two inches wide has been opened in which patches of high-grade ore occur. Assays run as high as 5000 oz. per ton, while the walls of the vein contain good milling ore. The high-grade ore is being sacked, while the low-grade ore is being hoisted through the leased shaft of the Right-of-Way mines for shipment to the custom plant.

The Consolidated Gold Mines Co. during 1920 produced 510,000 oz. of silver from its mines at Cobalt, namely, the original La Rose, the Violet, the Princess, and the University. The net loss from operation was \$5000. Costs were reduced to 73c. per ounce as compared with \$1.05 in 1919, but the lower price for silver offset this improvement. Only the richer ores will be mined during the present year.

PERSONAL

The Editor invites members of the profession to send particulars of their work and appointments. The information is interesting to our readers.

S. H. Dolbear is in New York.

V. P. Stanley Low is in Sweden.

Morton Webber has gone to Santa Barbara.

W. W. Mein is expected here on or about March 15.

G. A. Harrison has returned from Siberia to London.

Frank Pool has returned from Guanajuato, Mexico, to San Francisco.

Charles Jaudin has returned from Washington to San Francisco.

Percy R. Middleton, of New York, is here to conduct some experiments in roasting.

Hugh Kerr has been appointed inspector of mines in the Federated Malay States.

J. H. Ivey has been appointed manager for the Corocoro United Mines, Ltd., Bolivia.

Thomas H. Stearns, with a party of friends from Denver, sailed for Honolulu on March 2.

Glenville A. Collins has opened offices as consulting mining engineer at Vancouver, B. C.

S. H. Brady has moved his office from Reno, Nevada, to the Alto building, San Francisco.

Frank Hodges, assistant manager for the Cananea Consolidated Copper Co., is at Bisbee.

Arthur Wade is consulting engineer to the Commonwealth of Australia and is residing in London.

Arthur W. Stevens is superintendent for the Golden Age Junior Mining Co., of Lansing, Michigan.

Shinjiro Hirai, mining engineer with Mitsui & Co., Ltd., of Japan, has been visiting the mines of Utah.

Young J. Pentland, of Edinburgh, Scotland, director of the Arizona Copper Co., was recently at Clifton, Arizona.

F. G. Janney, general superintendent of mills for the Utah Copper Co. at Garfield, spent a few days in San Francisco recently.

James Irving has recently made an examination and report on the property of the Alamo Gold Mining Co., in Yuma county, Arizona.

Hjalmar E. Skouger, of New York, is planning a trip to Europe, and purposes to visit London, Brussels, Hamburg, and Copenhagen.

O. B. Smart has been appointed construction engineer for the Compañia Mexicana de Petroleo, with headquarters at Tampico, Mexico.

Charles S. Witherell, recently on the metallurgical staff of Guggenheim Brothers, has entered private practice as metallurgical engineer at 150 Nassau St., New York.

C. H. Macnutt has been appointed to take charge of the Vimy Ridge property of the Bennett-Martin Asbestos & Chrome Mines, Ltd., of Coleraine, Quebec, Canada.

J. C. L. J. Seelig, a mining engineer associated with the Dutch East Indies Portland Cement Co. in Sumatra, is visiting the mining districts of the West. He is now at Denver.

H. C. Rizer, Chief Clerk of the U. S. Geological Survey, was given a dinner recently to celebrate his 35 years of service with the Survey and received many tokens of appreciation.

G. C. Mackenzie, formerly secretary of the Munitions Resources Commission of Canada, has been appointed secretary-treasurer of the Canadian Institute of Mining and Metallurgy.

W. A. Carlyle has resigned as managing director for the British America Nickel Corporation and will sail on March 12 from New York to London, where he will re-establish his headquarters.



METAL PRICES

San Francisco, March 1

Aluminium-dust, cents per pound.....	65
Antimony, cents per pound.....	6.50
Copper, electrolytic, cents per pound.....	13
Lead, pig, cents per pound.....	4.25-5.25
Platinum, pure, per ounce.....	\$70
Platinum, 10% iridium, per ounce.....	\$100
Quicksilver, per flask of 75 lb.....	\$47.50
Spelter, cents per pound.....	8
Zinc-dust, cents per pound.....	12.50-15.00

EASTERN METAL MARKET

(By wire from New York)

February 28.—Copper is inactive and weak. Lead is quiet and lower. Zinc is dull but easy.

SILVER

Below are given official or ticker quotations for silver in the open market as distinguished from the fixed price obtainable for metal produced, smelted, and refined exclusively within the United States. Under the terms of the Pittman Act such silver will be purchased by the United States Mint at \$1 per ounce, subject to certain small charges which vary slightly but amount to approximately three-eighths of one cent. The equivalent of dollar silver (1000 fine) in British currency is 46.65 pence per ounce (925 fine), calculated at the normal rate of exchange.

Date		New York cents	London pence	Average week ending		Pence
Feb.	22 Holiday			Jan.	17.....	66.14
"	23.....	57.50	32.75	"	24.....	66.56
"	24.....	56.00	32.00	"	31.....	64.52
"	25.....	54.37	31.37	Feb.	7.....	61.66
"	26.....	54.75	32.00	"	14.....	61.70
"	27 Sunday			"	21.....	58.81
"	28.....	56.25	33.00	"	28.....	55.67
Monthly averages						
Jan.	1919	1920	1921	Jan.	1919	1920
Feb.	101.12	132.77	65.95	July	106.36	92.04
Mch.	101.12	131.27	59.55	Aug.	111.35	96.23
Apr.	101.12	125.70	....	Sept.	113.92	93.66
May	101.12	119.56	....	Oct.	119.10	83.48
June	107.23	102.69	....	Nov.	127.57	77.73
	110.50	90.84	....	Dec.	131.92	64.78

COPPER

Prices of electrolytic, in cents per pound.

Date		Average week ending		Date		Average week ending	
Feb.	22 Holiday			Jan.	17.....	12.75	13.08
"	23.....	12.75		"	24.....	12.75	13.00
"	24.....	12.75		"	31.....	12.75	12.87
"	25.....	12.62		Feb.	7.....	12.87	13.00
"	26.....	12.62		"	14.....	12.83	12.67
"	27 Sunday			"	21.....	12.83	
"	28.....	12.62		"	28.....	12.67	
Monthly averages							
Jan.	1919	1920	1921	July	1919	1920	1921
Feb.	20.43	19.25	12.94	Aug.	20.82	19.00	....
Mch.	17.34	19.05	12.84	Sept.	22.51	19.00	....
Apr.	15.05	18.49	....	Oct.	22.10	18.75	....
May	15.23	19.23	....	Nov.	21.66	16.53	....
June	15.91	19.05	....	Dec.	20.45	14.63	....
	17.53	19.00	....		18.53	13.18	....

LEAD

Lead is quoted in cents per pound, New York delivery.

Date		Average week ending		Date		Average week ending	
Feb.	22 Holiday			Jan.	17.....	5.11	5.11
"	23.....	4.40		"	24.....	4.89	4.79
"	24.....	4.20		"	31.....	4.71	4.52
"	25.....	4.00		Feb.	7.....	4.12	
"	26.....	4.00		"	14.....		
"	27 Sunday			"	21.....		
"	28.....	4.00		"	28.....		
Monthly averages							
Jan.	1919	1920	1921	July	1919	1920	1921
Feb.	5.60	8.65	4.96	Aug.	5.53	8.63	....
Mch.	5.13	8.88	4.54	Sept.	5.78	9.03	....
Apr.	5.24	9.22	....	Oct.	6.02	8.08	....
May	5.05	8.78	....	Nov.	6.40	7.28	....
June	5.04	8.55	....	Dec.	6.76	6.37	....
	5.32	8.43	....		7.12	4.76	....

TIN

Prices in New York, in cents per pound.

Date		Average week ending		Date		Average week ending	
Jan.	1919	1920	1921	July	1919	1920	1921
Feb.	71.50	62.74	35.94	Aug.	70.11	49.29	....
Mch.	72.44	59.87	32.16	Sept.	62.20	47.60	....
Apr.	72.50	61.92	....	Oct.	55.79	44.43	....
May	72.50	62.17	....	Nov.	54.82	40.47	....
June	72.50	54.99	....	Dec.	54.17	36.97	....
	71.83	48.33	....		54.94	34.12	....

ZINC

Zinc is quoted as spelter, standard Western brands, New York delivery, in cents per pound.

Date		Average week ending		Date		Average week ending	
Feb.	22 Holiday			Jan.	17.....	6.00	5.98
"	23.....	5.35		"	24.....	5.42	5.40
"	24.....	5.25		"	31.....	5.41	5.35
"	25.....	5.15		Feb.	7.....	5.20	5.20
"	26.....	5.15		"	14.....	5.15	5.15
"	27 Sunday			"	21.....	5.10	5.10
"	28.....	5.10		"	28.....	5.10	5.10
Monthly averages							
Jan.	1919	1920	1921	July	1919	1920	1921
Feb.	7.44	9.56	5.86	Aug.	7.78	8.18	....
Mch.	6.71	9.15	5.34	Sept.	7.81	8.31	....
Apr.	6.53	8.93	....	Oct.	7.57	7.84	....
May	6.49	8.76	....	Nov.	7.82	7.50	....
June	6.43	8.07	....	Dec.	8.12	6.78	....
	6.91	7.92	....		8.69	6.03	....

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, according to quantity. Prices, in dollars per flask of 75 pounds.

Date		Average week ending		Date		Average week ending	
Feb.	1.....	50.00		Feb.	15.....	50.00	
"	8.....	50.00		"	22.....	47.50	
				"	28.....	47.50	
Monthly averages							
Jan.	1919	1920	1921	July	1919	1920	1921
Feb.	103.75	89.00	50.00	Aug.	100.00	88.00	....
Mch.	90.00	81.00	48.75	Sept.	103.00	85.00	....
Apr.	72.80	87.00	....	Oct.	102.60	75.00	....
May	73.12	100.00	....	Nov.	86.00	71.00	....
June	84.80	87.00	....	Dec.	78.00	56.00	....
	94.40	85.00	....		95.00	52.50	....

RAILROAD EARNINGS

The exhibit which we present today of the gross and net earnings of United States railroads for the month of December is a distinct disappointment, says the 'Commercial & Financial Chronicle'. The disappointment consists not in the absence of very substantial improvement over the previous year, for as a matter of fact the earnings, both gross and net, are very materially better than in the corresponding month of the previous year, but in the failure of the improvement to reach the proportions counted upon. The December gains, while, as already stated, of substantial proportion, are very much smaller than those for November. In brief, the gain for December is only \$96,073,439 in gross and \$13,804,825 in net, whereas for November our tabulation had shown no less than \$154,239,572 addition to the gross and \$37,533,530 addition to the net.

The expectation of larger, rather than smaller, improvement for December than for November was based on the idea that operating costs would be greatly modified for the better, first by reason of the likelihood that the extra maintenance outlays which the carriers have been incurring in the effort to bring the roads back to the physical state existing before the advent of Government control would be materially lessened, and secondly by reason of the restoration of greater efficiency of operation through better discipline among the employees, whose morale had been seriously impaired during Government operation. But an entirely new factor has come into the calculation. There has been a great shrinkage in the volume of traffic moving.

A good test of the shrinkage is found in a comparison of the ratios of gain for the two months. For December this ratio of increase in the gross is only 21.68%, while for November the ratio was 35.21. This ratio of 21.68% increase is far less than what the increase from the rate advances alone should have yielded if traffic for December 1920 had been maintained at the level of that for December 1919. This will be obvious when it is recalled that the Interstate Commerce Commission in its decision of last July authorized an increase in freight-rates of 40% on the railroads in Eastern territory, of 25% on those in the South and those in the Mountain-Pacific district, and of 35% on the Western group of roads.

On the other hand, there is evidence that the carriers succeeded in gaining better control of their expense accounts in December. This is found in the circumstance that the expenses for December ran only \$82,268,614 heavier, or 20.28%, than in the previous year, whereas in November the augmentation in expenses had reached \$116,706,042, or 29.94%. The fact, therefore, that the gain in net in December was so materially reduced is to be ascribed entirely to a falling off in traffic with the coincident shrinkage in the gains in the gross. The following shows the comparative figures:

Month of December—		1920	1919	Increase,	
Miles of road.....		229,422	228,134	1,288	00.56
Gross earnings.....		\$539,197,015	\$443,124,176	\$96,073,439	21.68
Operating expenses.....		\$487,874,936	\$405,606,322	\$82,268,614	20.28
Net earnings.....		\$51,322,679	\$37,517,854	\$13,804,825	36.79

MONEY AND EXCHANGE

Foreign quotations on March 1 are as follows:

Sterling dollars:	Cable	3.89 1/2
	Demand	3.90 1/4
Francs, cents:	Cable	7.29
	Demand	7.31
Lire, cents:	Cable	3.72
	Demand	3.72
Marks, cents:	Cable	1.68
	Demand	1.68

Eastern Metal Market

New York, February 23.

Pronounced inactivity pervades all the markets, and prices in most cases are weak.

The tone of the copper market is weak, and prices are a little softer than a week ago.

The tin market is fairly stationary in price, but buying is small.

There is no demand for lead, and prices of the leading interest and of the outside market have fallen.

Demand for zinc is still negligible and at last prices have declined.

Antimony is lower.

IRON AND STEEL

With new buying so small that it is difficult to estimate and a receding scale of operations on the part of the United States Steel Corporation, thoughts are now centred on transportation charges as one element in manufacturing costs which has not had a revision, says 'The Iron Age'. Demand is developing for a readjustment of railroad wages and then of railroad freight-rates. New low prices have been named. There is no disposition to tear the market wide open in view of the small amount of business available.

The Steel Corporation in the Chicago district has dropped to a 65% ingot operation and three blast-furnaces have been blown-out, 20 now being active out of 29. In Pittsburgh active-ingot-making is not more than 70% of the whole, as compared with about 80% a week ago. The leading independents appear to average about 25% and are active, as is true of the Steel Corporation, chiefly in pipe-making. Some mills are making steel in one week and rolling it the next.

It will not be surprising if a revision is made shortly of all rail freight-charges to the Pacific Coast from Pittsburgh and Chicago plants. If a reduction of one-third is made it will bring the all-rail rate somewhat below that of the water route.

COPPER

The temporary improvement in the market which existed for a brief term following the financing of the heavy stocks has given way to a decidedly weaker tone. Buying has fallen off so that it is barely sufficient to hold the price steady at the lower levels to which it has fallen in the last week. The decline has been about 1c. per pound. Electrolytic copper for prompt and early delivery is now 12.75 to 13c., delivered, while second quarter is held at 13 to 13.25c. Lake copper is nominal at 13.25 to 13.50c. with demand also very light. While there is some disposition on the part of some producers to sacrifice their product, they are few. Production is being curtailed and increasing strength is predicted as the season advances. Export buying is reported as better than domestic, but not heavy at best. The 1920 reports are now returned as 374,688 gross tons as compared with 227,169 tons in 1919 and 328,844 tons in 1918.

TIN

The market is quiet and steady but featureless. The principal item of interest is the belief among importers that the proposed tariff duty of 10c. per pound on the metal and 6c. on the ore will be established sooner or later. This feeling is so pronounced that sentiment among importers is decidedly blue. Such a law would cut down imports to the minimum and enable the five or six American producers to supply the American tin-consuming market within two years. The business transacted during the last week has been small. Consumers have been holding off. Dealers were buyers of cheap lots on the 16th, such as March shipment of Straits tin, at 31.50c. and later in the day at 32c. Spot

Straits, New York, has held fairly firm around 33c., New York, being quoted on Monday at 32.50c. The London market on Monday was about 12 per ton lower than a week ago at £170 for spot standard, £173 10s. for future standard, and £190 for spot Straits.

LEAD

After maintaining its price at 4.75c., New York and St. Louis, for several weeks, the leading interest has reduced its quotation three times in the last week or from 4.60c., then to 4.50c., and finally to 4.40c., where it now stands. Buying is confined to small lots and there is very little interest in the market. The outside market is quoted at 4.15c., St. Louis, and 4.40c., New York. The lack of buying support is the cause of the decline and the market is stale and dull.

ZINC

There is still no improvement in this market. Quotations have at last broken 5c., St. Louis, after remaining there for some time. Prime Western can now be bought at 4.95c., St. Louis, or 5.45c., New York, for the domestic product. The imported metal is available at 5.35c., seaboard, for early delivery. The large electrolytic plant of the Anaconda Copper Mining Co., at Great Falls, Montana, was ordered shut-down on February 28.

ANTIMONY

This market has declined. Stocks are apparently large and buying is at a low ebb. We quote the market at 5.20c., New York, duty paid, for wholesale lots for early delivery.

ALUMINUM

Virgin metal, 98 to 99% pure, is quoted by the leading interest at 28c. f.o.b. producer's plant, for wholesale lots for early delivery, while other sellers handling foreign metal ask 23.50 to 24.50c., New York.

ORES

Tungsten: Pending some decision on the tariff, the market remains stationary and uninteresting. Demand is very small. Ordinary ore is quoted at \$2.75 to \$3 per unit in 60% concentrate.

Ferro-tungsten, guaranteed as to quality, is quoted at 58c. per pound of contained tungsten with the unguaranteed at 38 cents.

Molybdenum: There is no interest in the market and quotations are nominally unchanged.

Manganese: Buyers are not interested and quotations are unchanged at 35 to 40c. per unit, seaboard.

Manganese-Iron Alloys: Domestic ferro-manganese can be now obtained at a price on a par with re-sale material or \$92 to \$95, delivered. British alloy is unchanged at \$100, seaboard. Except for a few carload lots there is no inquiry to test the market on a large scale. Spiegeleisen is quiet and nominal at \$35 to \$40, furnace, for the higher grade.

Throughout the week there was a heavy decline in the price for silver in London, partly because India was out of the market, and partly as a result of the situation in China. The Continent made small sales. However, the difference between spot and forward is narrowing, says the latest market letter of Srinvas R. Wagel of New York. The local market continues to be lifeless. Prices are maintained at present levels mainly because of the strength of Sterlings. There is very little demand, even for the trade. At present there is practically no business in China, and the prices there are below the levels of both London and New York.



T. A. RICKARD, Editor

CORRECTED statistics of the world's production of oil in 1919 show that the total was 544,885,000 bbl., which is 5% more than the output in 1918. This increase came entirely from the United States and Mexico, each of which made gains of a little over twenty million barrels. Of the grand total, the United States contributed 69% and Mexico 16%. Russia was third with 5% and the Dutch East Indies fourth with 3%.

ACCORDING to Dr. Henry A. E. Chandler, who writes in the current issue of 'Commerce Monthly', a general commodity sales-tax offers the best means of supplementing the national income. He argues that such a tax would be a burden on those outside the scope of the Federal taxes only if a comparatively high rate were adopted, namely, 1% or more. On the basis of 0.3%, however, he maintains that an additional revenue of about \$500,000,000 would be raised, the application of the tax would be broad, and the rate would be so small as to minimize evasion and to lessen exemption. The proposal is sound and the idea is attractive. The levying of a tax of such a character would tend to equalize the burden.

HEARST'S suit to restrain the Secretary of the Treasury from extending credits to foreign countries has come to an ignominious end. As a piece of publicity, calculated to impress the readers of the yellow press and Americans in general with the noble and patriotic motives of its sponsor, it was a complete fizzle. The Government's reply was short and to the point: the Secretary of the Treasury had no intention of establishing additional credits for any foreign government, "as must have been known to the plaintiff when he filed his bill". Further, the plaintiff had no status enabling him to take the action he did, neither has the District of Columbia Supreme Court any jurisdiction to determine such a controversy. Mr. Hearst's activities in this particular case have added but little to the taxpayer's burden, as compared with the result of his previous injunction restraining the sale of ships, which, in consequence of obstruction, delay, and loss of trading opportunity, cost the American people about \$25,000,000.

MR. HOOVER'S accession to the cabinet of the new President will have pleased the members of the mining profession. It is announced that he intends to re-

organize the Department of Commerce, of which he is to have charge, and it remains to be seen whether he can make any important changes without trespassing on the departments of State and of the Interior. Perhaps the suggestions that he will be able to offer President Harding in regard to the re-organization of the various bureaus in his department will assist in furthering the plan to place all the engineering activities of the Federal administration under a re-organized Department of the Interior, to be known as the Department of Public Works. We hope so. It is an event in the history of the profession that a mining engineer should be in the Cabinet and it is equally auspicious that an editor-publisher should be the President. Some of us would have preferred to see Mr. Hoover appointed Secretary of the Interior and Mr. Hughes made Attorney General, but it is a satisfaction to all good citizens that these two eminent and capable men should be included in the Administration, to which we wish every success.

CORNELIUS F. KELLY, president of the Anaconda Copper company, and unofficial spokesman for all the mining companies of Butte in their dealings with the labor-unions, at a recent conference with representatives of the craftsmen on the question of renewing working agreements, took the opportunity to state the attitude of the employers with respect to some of the objectionable policies and practices of the workers. For years the mining companies and the local trade-unions, which do not include organizations of miners, have determined the conditions of employment and the wages to be paid by agreements made in advance and for a prescribed period. Occasional friction has ensued, but in general both parties have respected the terms of these agreements. Certain tendencies on the part of the union men have become gradually more pronounced, however, and Mr. Kelly frankly points out what these tendencies are and why they are opposed by the companies. Aside from the universal objection to trade-unionism, namely, the advocacy of the principle of retarding work, which, according to Mr. Kelly, prevails nowhere to a greater extent than at Butte, there are a number of proceedings to which the employers take exception. One is the persistent demand on the part of the unions to have classed as 'skilled' many kinds of work that require no mechanical training, in order to compel the company to employ more men at

higher wages. Another is the constant dissension among the different unions over the question of 'jurisdiction', that is, the classification of the work that must be left exclusively to members of the different unions. An illustration will serve to show the ridiculous waste and inefficiency that results from the attempt of each union to appropriate to itself the sole right to perform certain manual operations: A small electrically driven fan is to be installed underground. It is necessary to send an electrician and his helper, a carpenter and his helper, and a machinist and his helper to perform a task that would be an easy one for two intelligent miners, of which there are hundreds working underground at Butte. Even then a long argument is possible between the machinist and the electrician, both of whom, according to the overlapping claims of their respective unions, would have 'jurisdiction' over the tightening of certain bolts or some other equally simple operation. Helpers of the various denominations are necessary because a machinist's helper must not hand a wrench to an electrician, nor a hammer to a carpenter; nor is it permissible for a machinist to work without a helper, who, besides carrying his tools, generally supplies him with tobacco. These things seem too ridiculous, yet they are literally true; that they must be a source of great annoyance and expense to the employer is obvious. After pointing out several other objectionable tendencies in the conduct of the unions, Mr. Kelly displays a desire to meet the men half-way when he says: "If we can establish reasonable working conditions, reasonable rules under which we can go ahead and do business, and if we can do away with these practices which we feel are foolish and oppressive, there is no reason why we cannot proceed amicably, fairly, decently, and self-respectingly, and co-operate in our work."

FROM Mexico there comes a polite, but belated, protest against sundry remarks of ours on the subject of racial migration to which we gave expression in our issue of November 6, after reading Mr. Lothrop Stoddard's book on 'The Rising Tide of Color'. To this protest, from Señor F. Benitez, we are glad to give space, for there is a good deal of truth in what he says, as there was in what we said. Most discussions of historic movements are vitiated by race prejudice, and it would appear as if we were not immune from the disability. The Spaniards were great explorers and colonizers, we must agree, and if we have under-rated their share in the opening up of new lands, we apologize to our courteous correspondent south of the Rio Grande del Norte. We are obliged, however, to note that he also makes claims a little in excess of those warranted by facts, for he says that the States of California, Florida, Arizona, Texas, and Nuevo Mexico "bear Spanish names" and "have nothing Northern about their names". This provokes inquiry. The origin of 'California' is uncertain, but it is now generally allowed to have been the name of a fictitious island mentioned in a Spanish romance printed in the 16th century. Florida was the name given to the country discovered by Ponce de Leon because he landed on Easter day, called in Spanish *pascua florida*, the

flowery passover. So far so good for Señor Benitez. But Carolina is not Spanish, but English. The original colony was named after Carolus, that is, Charles II. Arizona is a Spanish corruption of the Indian (Papago) word *ortison*, meaning little creeks. Texas is of Indian origin and means 'friends'. We have no State named Nuevo Mexico; it is New Mexico, which is English, although etymologically a hybrid because 'Mexico' is the Spanish form of the Aztec equivalent *Metli*.

Copper

The production of copper from the leading mines of the United States has been cut down to a point where any further decrease would entail the cessation of operations. The diminution, as compared with 1917, is more than 50%. In 1920 the total domestic production of copper was 617,500 tons, which compares with 963,925 tons in 1916 and 612,242 in 1913. It is evident that not until the very end of 1920 did the producers diminish their outputs to meet market conditions, which it had been hoped continually would improve, but which did not improve because economic conditions in Europe remained adverse to any large absorption of American copper. A glance at the statistics of export shows that the stagnation in the market for copper is readily explicable. In 1920, we exported 28.6% of the refinery output; in 1913, as much as 53%; in 1908, 59%. A considerable proportion of this trade was stimulated by the preparation for war; how much, nobody knows. The statistics of copper are complicated now by the production of American-owned mines in South America, Mexico, and Canada. That is why the output of the refineries in the United States is about 225,000 tons more than the domestic production of the metal. At the beginning of 1920 the surplus stock of copper was 700 million pounds, which was reduced only a little during the year, leaving a stock of about 640,000,000 pounds at the beginning of 1921. During last year the Chile, Braden, and United Verde Extension mines increased their outputs, in the aggregate, by 55 million pounds, equivalent to the annual yield of one big mine, such as the Miami or Cerro de Pasco. So long as copper is selling for 13 cents per pound, there is no incentive to produce. The Federal Trade Commission, after careful investigation, estimated the average cost of the American output of copper in 1919 at 16.17 cents per pound. Fifteen years earlier the average price was estimated on good authority at 13 cents. At that time, in 1904, the Calumet & Hecla's cost was 8 cents and that of the Wolverine 5.17 cents per pound. Ten or twelve years ago it was the fashion, especially among stockbrokers, to talk glibly about the 4-cent copper that was going to be produced by the big low-grade mines. In 1916 the Utah Copper company produced its copper for 6.95 cents per pound; in the last quarter of 1920 the cost was 17.3 cents per pound; or, deducting the value of the precious-metal contents and miscellaneous income, it was 15.16 cents per pound. The United Verde Extension produced for 8½ cents; in 1917, for 6.4 cents. In the expansive days of early 'porphyry' promotions, it was customary to disre-

gard depreciation of plant and various general charges, and thereby whittle the cost down to most attractive figures. Nowadays these items loom large, and to them have to be added Federal taxes that are no joke. In 1919, according to the Federal Trade Commission, only six companies could produce copper for less than 13 cents per pound and they contributed only 14½% of the total production. The current surplus has been estimated all the way from 600 to 900 million pounds, the discrepancy being due to the fact that about 300 million pounds is normally in stock and in transit between the mine and the market, so that the real excess overhanging the market at the beginning of the year was about 400,000,000 pounds. It was to liquidate this accumulation of metal that the Copper Export Association, representing companies producing 75% of the American output, issued \$40,000,000 in notes during February, for expediting the sale of the metal in Europe by means of an extension of credit to foreign consumers. This should remove a heavy incubus from the market, and if, and when, peace is declared with Germany, it should lead to an expansion of our export trade, on which, of course, the domestic price depends.

Industrial Research

An article on the standardization of mining and milling materials appears on another page of this issue. The subject is one of more than local interest, considering the need for economy of expenditure and efficiency of operation in many branches of metal mining. Mr. E. A. Wright, the author of the paper, deals at length with the question of suitability and heat-treatment of the various types of drill-steel in use. This appears to have been the only subject on which he found that a determined effort had been made to collect data and to compile specifications based upon scientific research. The work was carried out some years ago by the Mines Trials Committee at Johannesburg, a progressive body supported by the mining companies, and financed so that investigations of a worth-while character could be made by competent men. A competitive test had previously been carried out with various types of drilling machines, and considerable benefit accrued to the industry as a result. Mr. Wright's paper elicited much contributory information in the form of a healthy discussion. The engineer in charge of the earlier drill-steel tests gave interesting particulars of the work done, which was carried out in a specially constructed tool-shop at the Robinson Deep mine. The tests extended over twelve months, during which time 99 types of steel were received, 559 experiments being made on four- or five-drill sets. Loss of reaming efficiency and loss of weight per inch drilled were calculated, and other observations were recorded. Electric, crude-oil, and paraffin furnaces, of both the vertical and horizontal types, were tried, leading to the development of a simple furnace of special design, which was afterward adopted for ordinary mine-work, heating 2700 hand-drills per shift. Interesting points were developed during the investigation with reference to the size of the steel and the

relative carbon content, the greater comparative superiority of the cheaper steels, water temperature for quenching, and the composition of the steel.

At the recent meeting of the American Institute of Mining and Metallurgical Engineers, at New York, Mr. Van. H. Manning, during the discussion of a paper on the same subject, proposed that the directors of the Institute should appoint a board to engage in research on drill-steel, and that the expense should be shared by all the engineering societies interested. The resolution was unanimously adopted. It marks a step in the right direction, but we would prefer to see the subject taken up by those directly interested, namely, the mine-owners themselves. The Institute is already top-heavy with boards and committees; it has difficulty, apparently, in managing efficiently the work now in hand. Surely the units in every industry ought to realize that co-operative action and an outlay in proportion to the magnitude of their individual activities would, if properly directed, be extremely beneficial. Government departments, like engineering societies, are not always efficiently operated; often they ignore too many of the controversial problems, the importance of which is only realized by those engineers who have had considerable experience. Moreover, such bureaus pay too little to attract the type of man needed for research. The output of published effort of six \$200-per-month men is usually ten times more voluminous but often contains less of real value than might be secured from a single concise report of one \$1000-per-month expert. We doubt, for instance, whether the Bureau of Mines can be truly efficient until it ceases to be used as a stepping-stone to a better or more lucrative position in routine professional or commercial work. There is a great deal to be said in favor of a research institution controlled and supported directly by the industry. Efficient standardization can only be secured by the co-ordination of scientific research with industrial effort. If both can be placed under joint control, so much the better.

Conkling v. Silver King Coalition

Posts and other survey monuments, the existence and original position of which can be established by evidence, prevail over the written description by courses and distances as set forth in the plat and field-notes of a mining claim as filed in the General Land-Office at the time of patent, when a discrepancy between the two exists, according to the decision of the U. S. Supreme Court handed down on February 28, in the suit of the Conkling Mining Company v. the Silver King Coalition Mines Company. The case came up for review on a writ of certiorari granted to the Silver King company after the original decision in its favor by Judge John A. Marshall in the U. S. District Court of Utah had been reversed by the Circuit Court of Appeals. The present ruling relieves the Silver King company from paying \$706,800 to its opponents in the litigation. This sum represents the amount fixed by the trial court, and confirmed by the Circuit Court, with interest to date.

Suit was first instituted in January 1908, the Conkling company alleging that the Silver King company had secretly discovered and removed sundry valuable ores that underlay the Conkling lode claim in the Utah mining district, commonly known as the Park City district, in Utah. The companies were co-owners of the claim, the Conkling interest being three-fourths of the whole. The defendant set forth three distinct defences, but only the second is involved in the recent decision of the Supreme Court. In this it was contended that the true boundaries of the Conkling claim were not those described in the patent from the United States "in that the claim as patented was not 1500 feet in length as bounded and described therein, but only 1364.5 feet, leaving 135.5 feet of the claim (in which were found the ores), belonging to the Silver King under subsequent overlapping patents granted to its predecessors in interest". Strangely enough, the Elephant stope, from which the ore in question was taken, appears to lie entirely beneath this westerly 135.5 feet of the Conkling claim as it is described in the patent; or entirely without the claim as it is bounded by the end-line established by certain posts that the Silver King company undertook to prove actually had existed and therefore governed the true position of the westerly boundary, regardless of the courses and distances specified in the patent. Counsel for the Conkling company contended that parol evidence as to monuments not called for in the patent, which they construe to be a deed from the Government, is not admissible to vary the plain terms of the description; that no evidence is admissible to vary the boundaries as set forth without ambiguity in the patent; and that the Brooks Act of 1904, by which it was provided that the line as run by the surveyor should control over courses and distances, should not have a retroactive effect. They argued further that, even if the admissibility of evidence attempting to establish the position of the corner-posts as set during the survey for patent in November 1889 were conceded, grave doubt attached to any evidence respecting the finding of such easily movable monuments because of the situation of the claim on a mountainside where heavy snowfalls occurred each winter, and where sheep and cattle grazed in summer; and because of the frequent practice of surveyors, in districts where there are many claims, of replacing missing corner-posts at points where they believe they formerly had been. It appears that corners No. 1 and 2 were, and still are, definitely established, that they were marked by "posts set in the ground", and that these posts were mentioned specifically in the patent, whereas no posts were mentioned as designating corners No. 3 and 4, which are at the extremities of the end-line under dispute. This is construed by the Conkling side as indicating the absence of any monument marking these corners at the time of the survey for patent.

Justice Holmes, who wrote the opinion of the Supreme Court, states the question in these words: "The Circuit Court of Appeals was of opinion that the patent represented an adjudication by the land department that the lot was 1500 ft. long and 600 ft. wide without regard to

the location of the other posts which the field-notes showed to exist, but the patent did not mention. The District Court, on the other hand, held that evidence was admissible to show that there were monuments at corners No. 3 and 4, held that the monuments so established prevailed, and, therefore, decided that the title of the Conkling Mining Co. failed". It is pointed out that one of the statutory requirements of a mining claim is that "the location must be distinctly marked on the ground so that its boundaries can be readily traced". A pre-requisite to the filing of an application for patent is the posting of a notice on the ground, for the information of adverse claimants. The patent can convey only the area for which such notice has been given, and the presumption is that some physical monument must exist to inform possible adverse claimants and the public in general of the true boundaries of the claim under consideration. Alluding to the Brooks Act, the opinion says: "The act of April 28, 1904, amending Revised Statutes 2327, making the monuments the highest authority to which inconsistent descriptions must give way, simply made more explicit or at most carried a little further, the previous policy of the law." As to the admissibility of evidence regarding the recording of marked posts at the third and fourth corners in the field-notes, and the testimony of witnesses as to seeing posts standing at the corners of the claim, the decision sustains the ruling of the trial judge in the District Court; with respect to this testimony it says "the District judge who saw and heard the witnesses was satisfied that they told the truth, and thereupon rightly determined that the monuments so fixed controlled the courses and distances in the instrument evidencing the grant. We see no sufficient reason for disturbing the finding of the trial court upon the facts".

The third defence set up by the Silver King company alleged that the orebodies in question were a part of the Crescent fissure-vein, the apex of which lay in sundry claims owned exclusively by that company, and that the right to pursue this vein extra-laterally beneath the surface of the Conkling claim precluded any rights of the Conkling company to the ore extracted from the Elephant orebody. Interesting questions regarding the application of the law of extra-lateral rights are involved, but these will probably not be brought to issue in view of the final decision with respect to the claim boundary. It is rather remarkable to note the number of men directly interested in this suit who have died during recent years. Thomas Kearns, once U. S. Senator from Utah, and David Keith, the organizers and principal owners of the Silver King Coalition, are dead; so is Nicholas Treweek, owner at one time of the three-fourths interest in the Conkling claim and the largest stockholder in the Conkling Mining Company. Treweek spent a fortune driving the Hanauer adit into this same mountain but fate did not favor his efforts. Edward B. Critchlow and W. J. Barrette, of the law-firm that represented the Conkling company, and Curtis H. Lindley, of San Francisco, who appears as one of the Counsel for the Silver King, have all crossed the range within the last year.

DISCUSSION



The Rising Tide of Color

The Editor:

Sir—I feel compelled, for the sake of historical truth and bare justice, to challenge some of the ideas expressed by you in the editorial that bears the above caption, which, to my way of thinking, are not based upon facts.

Speaking of the onrush of the colored races during the 15th century you say "the Moors occupied half of Spain". It was precisely during the 15th century that the Spanish armies under Ferdinand and Isabella expelled the last Moorish king of Granada, Boabdil, from Spain in 1492, after a long and bitter struggle that lasted eight centuries.

At that time (the 15th century) the part of Spain occupied by the Moors was nothing like half; it did not reach one-tenth. Again you continue: "the brown men dominated the shores of the Mediterranean. Thereupon the people of Northern Europe took to the sea and colonized distant lands with their virile stock; the dark invaders were driven back into Asia and Africa". You make no mention of the discoveries made by the Portuguese, Italians, and Spaniards, nor of the lands the first and last colonized for white civilization. Anybody would conclude from your statement that Columbus was an Englishman, Amérigo Vespucci a Scandinavian, and Magellan a Dutchman! As to the Turks having at that time unchallenged possession of the Mediterranean, this was far from being the case; for in the year 1492 the Spaniards besieged and captured the important stronghold of Ceuta, of great strategic value, as it commands the strait of Gibraltar, and therefore the passage between the Atlantic and Mediterranean seas. The efforts of the Christian peoples on the shores of the Mediterranean to end the sea-power of the Turks were continued in a most determined manner, and without any aid whatever from the Northern races, throughout the 15th and 16th centuries. This long struggle to down Turkish supremacy at sea culminated in the famous battle of Lepanto, in which the allied fleets of Spain and Italy, after a terrible and bloody encounter, won an overwhelming victory over the Turks and sealed forever their hopes of becoming the predominant sea-power in the Mediterranean. As an interesting sidelight from the main argument, I hope I may be pardoned for mentioning the name of one of the many famous Spanish soldier-writers of that epoch, who combined the agreeable and pleasant task of writing with the more arduous and dangerous one of fighting, and who took part in that memorable battle, losing an arm, namely, Miguel de Cervantes Saavedra, the immortal author of

'Don Quixote'. This goes to prove the popularity of that crusade against the Turk among all social classes in Spain.

It was, in fact, the taking of Constantinople by the Turks, and the consequent closing of direct communication between Europe and Asia, that made the Portuguese, Spaniards, Genovese, and Venetians set out to find a new and free route to India, other than through Constantinople. In these adventurous and early voyages the peoples of Northern Europe figure nowhere. They only followed in the wake of the Southern people at a much later date. Let us see if history confirms these assertions.

In their voyages around the west coast of Africa, with the hope of finding a new way to India, the Portuguese discovered and colonized Madeira and the Azores, and the Spaniards the Canaries. These islands served as outposts or stepping-stones in the longer voyages, first, around Africa and later in trying to reach India direct. It was a Portuguese navigator, Bartolomé Diaz, who first discovered the Cape of Good Hope, then called the Cape of Storms. It was also a Portuguese sailor, Vasco de Gama, who first turned the famous Cape. Cabral, also a Portuguese, discovered Brazil. America was discovered, although he died in ignorance of it, by one Cristóbal Colon, a Genovese geographer in the service of Spain, which country paid all the expenses and furnished all the men and ships for that expedition, which gave the white race a new continent. Amérigo Vespucci, a Florentine navigator, who accompanied Columbus on many of his voyages, also did much in the way of exploring the newly discovered lands. A Spaniard, Vasco Nuñez de Balboa, in 1513, discovered the South or Pacific Ocean from the isthmus of Darien and proved that Columbus had not reached India, as he thought, but that the new lands belonged to another continent. Another Spaniard, Juan Diaz de Solis, in 1515, in trying to find a way from the Atlantic to the Pacific Ocean (discovered two years previously by Balboa) discovered the river Plate. The glory of finding the much sought-after path from one great ocean to the other fell to another Portuguese, in the service of Spain, namely, Fernando de Magellan, whose name, with justice, the straits bear today. In that dangerous expedition Portuguese, Spaniards, and Italians were closely associated. After the death of Magellan, killed in a fight with some savages on one of the Philippine islands, a Spaniard, Sebastian del Cano, took command and completed the first voyage around the world. Out of the 237 men who made up the crews of Magellan's five ships, 157 were Spaniards, 24 Portuguese, 22 Italians, 21 French, five Flemish, three Greeks, two

Germans, one English and one Malay. That is to say, the Northern races were only represented by 8 men out of a total of 237 in that most memorable voyage, which, apart from the historical and romantic associations that it has for the colonials of the men who carried it to successful completion, in spite of tremendous difficulties and much sacrifice of life, was of inestimable value to geographical science and to mankind.

The name of the chief pilot of that expedition, Pigafetta, should be mentioned, for his knowledge of geography and astronomy was of great service to Magellan. He was the scion of a noble Italian family and left us the best, most truthful, and most complete diary of that voyage.

To end this already too lengthy letter, I will remind you, Mr. Editor, that many of the States that compose the Union today bear Spanish names. California, Florida, Carolina, Arizona, Texas, Nuevo Mexico have nothing Northern about their names no matter how Northern they may have become in their habits and culture; showing that they were discovered and colonized in their early days by people of a Southern race led by Hernán Cortez and Ponce de Leon.

Honor to whom honor is due.

F. BENITEZ.

Mexico City, February 14.

The Definition of 'Concentrator'

The Editor:

Sir—I note a short editorial in your issue of February 26, which you conclude with this statement: "The Appellate Division of the Supreme Court of Ontario has been fooled". Concentration as applied to the treatment of ore is a step in ore-dressing, and 'ore-dressing' by usage is a term confined to mechanical operations exclusively; it is not applicable to any treatment in which chemical reactions play an essential part, although one plant may readily combine ore-dressing with other processes.

It is certainly erroneous to use the term 'concentrator' in describing a plant in which gold and silver are extracted by treating, with cyanide solutions, the entire mass of the original ore. On the other hand, if a table-concentrate were made and this were cyanided, it might be argued that the plant was properly called a 'concentrator'. Or if 25% of the ore as hoisted were removed by hand as it passed by on a sorting-belt, the same argument might be used.

However, the point I wish to make is in reference to your statement that the Supreme Court was "fooled". I believe that there is a generally accepted principle that the intention of the law, where it can be established, must be given weight in interpreting disputed points. The probability is strong that the framers of the statute under which 'concentrators' are excluded from taxation had in mind any plant in which ore was crushed, ground, and otherwise treated with a view to recovering the valuable metals, excluding only the smelters. The refining, or smelting, of precipitate produced in the cyanide

process is not an essential part of the operation, for the precipitate can be and frequently is shipped to a smelter for further treatment. It would be difficult to convince some that 'cyanide' precipitate is not indeed a rich concentrate. Be that as it may, I am inclined to believe that the Court, while it may have wandered from the road of technical truth, finally arrived at the destination of real justice, which is not a too frequent result in this day and age.

ENGINEER.

San Francisco, March 2.

Electrolytic Zinc Refining

The Editor:

Sir—I notice in your issue of January 29 a description of metallurgical apparatus of the Judge Mining & Smelting Co., in which the writer, Mr. A. B. Parsons, repeatedly mentions this plant as being a "zinc refinery".

I wish to call to your attention the fact that this loose use of the word 'refinery' has become entirely too general in the Inter-mountain West. There is not a single electrolytic zinc refinery west of the Mississippi. Rather, there are electrolytic zinc deposition plants. A refinery is usually understood to be a plant in which an impure metal is refined to a much better grade of metal. Electrolytic zinc refining was practised on a commercial scale in the United States during the War, but is at present quiescent. Prime Western spelter was cast into anodes and treated by an electrolytic zinc refining process so designed that nothing but pure zinc was deposited on the cathodes, and the main impurities, consisting of cadmium, lead, and iron, were left either in the anode slime or in solution. Details of this process have been described in my book on the hydrometallurgy of zinc, and I have discussed electrolytic zinc refining at a recent meeting of the American Chemical Society, California Section, in San Francisco.

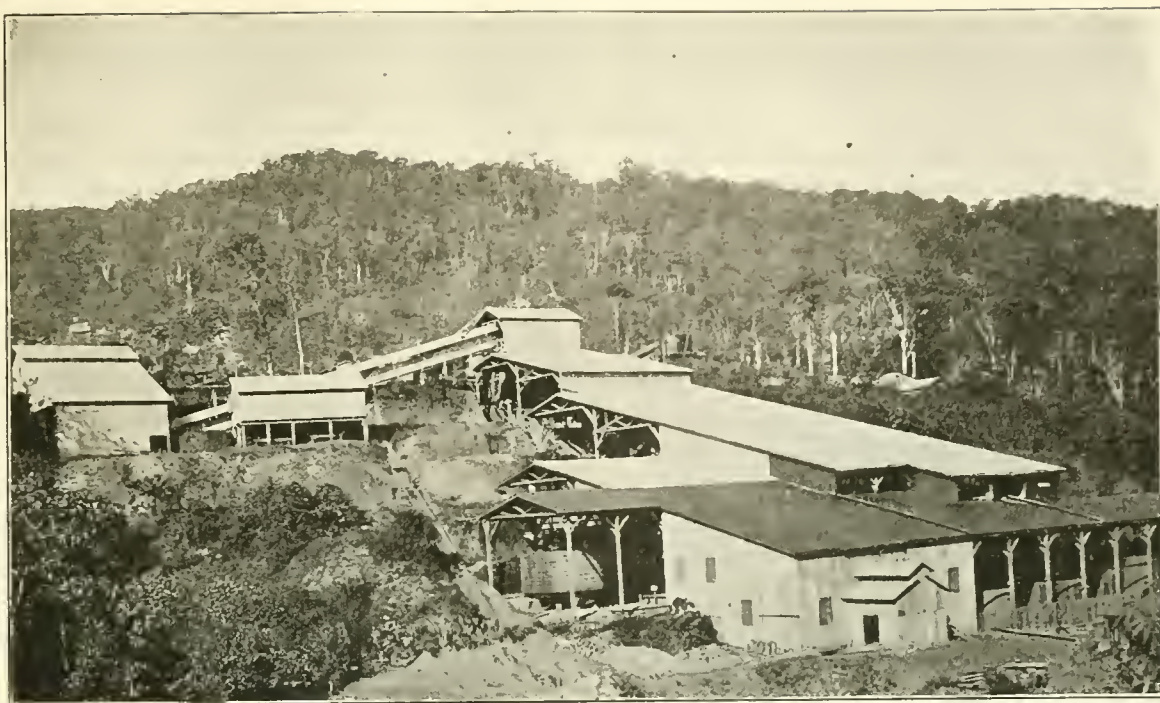
I trust that such an excellent rhetorician as yourself will agree with me in objecting to this abuse of the word 'refinery'.

O. C. RALSTON.

Seattle, February 9.

[Mr. Ralston's point is well taken, except for the fact that Mr. Parsons did not use the word 'refinery' anywhere in his article; instead he used 'zinc-plant' and 'electrolytic plant'. The word 'refinery' appears only under the illustrations of the flow-sheet and the cell-room. Mr. Ralston, apparently, did not read the article, only the captions under the cuts. The zinc precipitated in an electrolytic cell is fine, but it is not refined; the re-finishing process comes later.—EDITOR.]

ENGLAND is the chief destination of iron ore shipped from Bilbao, Spain, states a consular report. The French and Belgian markets have absorbed only small amounts. Toward November the exports to Germany showed a slight increase. The exports for 1920 amounted to 2,104,545 tons, as compared with 1,513,997 tons during 1919, and 2,253,428 and 2,072,519 tons during 1918 and 1917, respectively.



THE EDEN MINE AND CYANIDE PLANT

The Piz Piz Gold District, Nicaragua

By Robert Hawxhurst Jr.

The mining district of Piz Piz is situated in north-eastern Nicaragua, 80 miles from the Caribbean sea-coast and 70 south of the Honduras frontier. Its latitude is 14° north; and longitude $84^{\circ} 30'$ west of Greenwich. Although distant but a thousand miles from New Orleans, the place is practically as remote as is the heart of Africa. Set in the midst of a vast and impenetrable tropical forest, without access by railway, road, or navigable stream, its isolated location is attended by difficulties of transportation which must be experienced in order to be appreciated.

The route of travel from the United States to the mines is by steamer from New Orleans to Bluefields, a distance of 1200 miles; thence by small schooner to Prinzapolea, 90 miles up the coast; thence, by motor-boat or canoe, up the Prinzapolea and Banbana rivers to Tunky, a distance of 150 miles; thence by smaller canoe, 15 miles up the Tunky river to Miranda, whence the several mines are reached by tramway or saddle-mule, in the course of the same or of the following day. The journey from New Orleans can be made in 10 days, when all conditions are favorable; but usually twice this time is required. Freight shipments, being subject to delay at Bluefields, Prinzapolea, and Tunky, are seldom less than 30 days and often as much as two months in transit. Rates upon ordinary cargo are from \$130 to \$150 per ton, and upward for heavy machinery.

Bluefields, a town of some four thousand inhabitants, is the chief port of entry and the only harbor, on the east

coast of Nicaragua. Here are situated several large commercial houses and a branch of the National Bank. There is a weekly steamship service to and from New Orleans, wireless communication with that port, and telegraphic connection with the capital at Managua. Prinzapolea, a small town at the mouth of a river bearing the same name, is the coast outlet for the Siuna and Piz Piz mining districts. Tunky, a village at the junction of the Banbana and Tunky rivers, is the head of motor-boat navigation. The east coast is a sparsely-populated undeveloped territory separated from the rest of the republic by a 100-mile barrier of virgin forest and jungle. In addition to Bluefields there are but half a dozen settlements of a few hundred inhabitants each. Conditions are primitive in the extreme and the only industries are comparatively small-scale operations in the way of banana planting, mahogany logging, and gold mining.

The Prinzapolea-Banbana river affords the sole means of travel and transport between the Piz Piz mines and the sea-coast. Broad and deep over a tidal stretch extending some thirty miles from the sea, it quickly becomes a narrow and crooked stream, abounding in rapids and shallows, and the last 50 miles of its course to Miranda more aptly answers to the description of creek than of river. Freight is carried in barges of from three to five tons burden, towed by gasoline launches, specially designed for operation in shallow waters. When the river is high, launches ascend as far as Tunky, after being hauled through the strongest rapids by means of winches, sta-

tioned on the river bank. At Tunky, cargo is transhipped to pitpans, a type of native canoe fashioned from hollowed logs. These have a carrying capacity of from 500 to 1500 lb., and are slowly poled up stream where depth of water permits, and dragged by hand through the long stretches of shallows and rapids, to points where further progress is impossible. Freight is then unloaded and hauled to the mines by oxen or tramway, as the case may be. During periods of low water the river is closed to navigation above Yawaltarra rapids; during flood season the swiftness of current prevents the movement of boats up-stream. At all times the channel is blocked in places by tangled masses of stranded trees, logs, and brushwood, through which an open passageway is maintained with difficulty. The cost of moving freight up-river, a distance of 165 miles, is from 5 to 6c. per pound. In no other country in the world would such a stream be utilized for purposes of transportation, and its use here would be impossible but for the exceptional skill and hardihood of the Indian boatmen. In former years freight was brought in from Cape Gracias, by way of the Wanks, Waspue, and Piz Piz rivers, but because of the more dangerous rapids encountered, this route has been almost entirely abandoned in favor of the Prinzapolea. There are no roads in the country, their construction and maintenance being rendered impossible by the incessant rain, the presence of a deep clay soil, and the absence of suitable material for foundation and dressing. Rude trails connect the several mines; and freighting, about and between camps, is accomplished by means of pack-oxen and ox-teams, hauling mud-sleds and drags.

The climate is hot and humid. The average daily temperature is about 80°F., with a maximum annual range between 60° and 100°. Rainfall records, covering a period of 11 years, indicate an average annual precipitation of 123 in., with a maximum of 155 and a minimum of 68. The rainy season commences in May, to the accompaniment of violent electric storms, and lasts until the end of January; rain falls daily and, at intervals, continues for four or five weeks at a time, without intermission. The greatest downfall generally takes place during July and August, when the country becomes an immense quagmire. The so-called dry season, comprising February, March, and April, is merely a period of lesser rainfall, with a monthly average of 4 in. Rainfall is a feature of vital importance to the district, the mines being dependent upon river-transport for incoming food and supplies, and upon hydro-electric power for plant operation. When the annual precipitation is less than normal, river traffic is impeded; and diminished stream-flow, at power-plants, limits mine operation. Such restrictions were experienced in 1904, 1912, 1916, and 1918.

Before the discovery of gold, this section of Nicaragua was an unexplored wilderness, the only inhabitants of which were a few wild Indians, dwelling along the river banks. The present population, numbering some fifteen hundred in all, is composed of Nicaraguans, Indians, and negroes of West Indian descent. These derive their

livelihood solely from mining and allied activities; and their numbers vary from time to time, according to the local demand for labor. Soil and climate are unsuited to agriculture or cattle raising. Excepting small patches of bottom land, the unproductive clay soil bears but a very meagre covering of humus, the long rainy season is unfavorable to the maturing of crops, there are no natural pastures, and insect pests are legion. In consequence, a permanent farming element has never become established; and all food supplies, with the exception of a limited quantity of corn and fruit, are imported from New Orleans or brought in from the Pacific slope. Two small villages, San Pedro and Limon, cater to the tired miner along time-honored lines.

Both Nicaraguans and negroes are employed in the mines, mills, and power-plants. Under intelligent supervision they become excellent workmen and are good-natured, willing, and easily managed. Although individual efficiency falls below that of the mine worker in cooler climates, a lower wage-scale more than equalizes the difference. Indians are used altogether in manning the barges, bateaux, and canoes, engaged in river freighting; as boatmen they are unsurpassed in skill and endurance. The honesty and faithfulness of all classes are noteworthy. The prevalent diseases—malarial fever, dysentery, and hookworm—are largely responsible for the impaired efficiency of native labor.

The physiography of Nicaragua presents a diversity of feature, remarkable even for Central America, a land of smoking peaks, shattered cones, deep gorges, torrential streams, and lagoon-girt shores. The great break in continuity of the Continental Cordillera, extending from southern Mexico to Colombia, reaches extreme depression in the lake basin of Nicaragua, a portion of which is below sea-level. This basin is marked by a chain of volcanoes along its western border, from Coseguina to Ometepe. Four are active, eight quiescent, and five extinct. The main mountain system curves around the eastern shores of the lakes, with ramifying ranges stretching eastward toward the Caribbean, which terminate in semi-detached groups of hills, rising out of the coastal plain. This is low flat country of typical tropical aspect, densely forested, and traversed by the tortuous courses of numerous silt-laden meandering streams.

The mining district of Piz Piz embraces the watershed between the upper reaches of two such streams, the Piz Piz and Tunky, affluents respectively of the Wanks and Prinzapolea, which flow into the Caribbean. The explored territory forms a belt, ten miles in length by three in width, following the north-easterly trend of the local range of hills, with the Eden and Concordia mines situated at each extremity. The region is one of sharp relief. A succession of saw-tooth ridges and narrow canyons extends on all sides. The hills vary in height from 1000 to 1800 ft., culminating in Wawa peak to the north and Pia mountain to the south, with elevations approximating 4000 ft. From the main valleys, branches, with repeated bifurcations, cut deeply into the hills.

forming channels for run-off of the heavy rainfall. Hills and valleys alike are clothed in a dense growth of forest and jungle, which furnishes an ample supply of timber for all purposes, and incidentally harbors every species of insect, reptile, bird, and mammal known to the fauna of the American tropics.

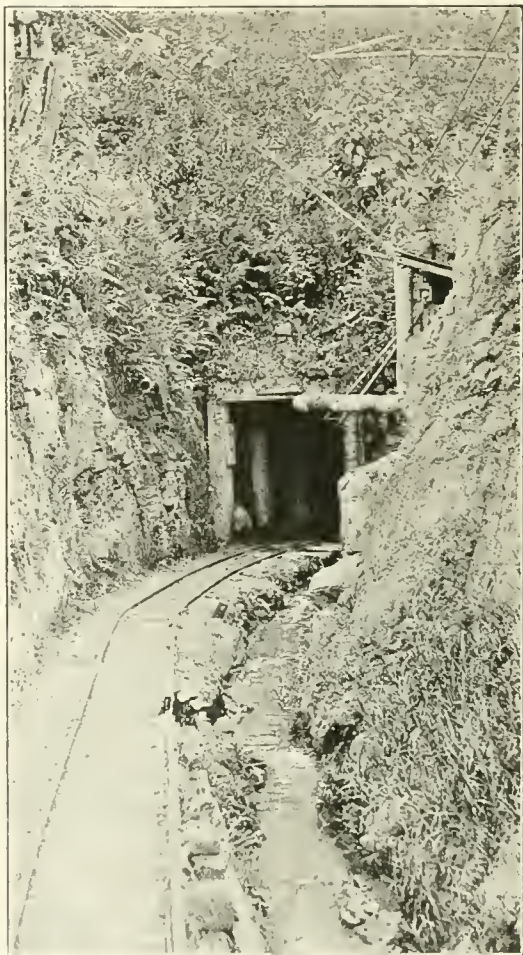
The general geology of the district is simple. In common with the greater part of northern Nicaragua, the older formations have been submerged beneath Tertiary and Recent lavas. Isolated exposures of granitic intrusives and of unclassified shales and limestones are found

there intruded by small dikes of more basic rock of the same series. Evidence of regional deformation is lacking. Fracturing seems due to contraction and gravitative settling, followed by lesser local disturbance. The resulting fissure system conforms to a roughly conjugated arrangement of more or less parallel major openings, opposed, but not crossed, by shorter and narrower fissures.

The veins occupying the major fissures vary in width from 10 to 25 ft., with occasional expansions to twice the latter figure. Their general strike of N. 45° E. corresponds to the trend of the more prominent mountain



ABANDONED MILL OF THE PANAMA MINING CO.



ENTRANCE TO EDEN ADIT

at lower elevations, in the outlying country to the north, south, and east. The rocks of the immediate district, however, are exclusively of the andesite-diorite series, but without occurrence of the extreme end grades. Composition, texture, and color are variable. Porphyritic varieties, characterized by light phenocrysts, are especially abundant. The prevailing colors are gray and green, incomplete alteration producing brown, red, and purple shades. The rock weathers rapidly; and, where spared by erosion, decomposes, to considerable depth, into red and yellow clay. Propylitic and sericitic alteration, in the vicinity of veins, are characteristic, and vary in degree and extent with size of veins.

The low-lying beds of effusive andesite are here and

ridges, of which they frequently form the backbone. Angles of dip vary between 25° and 75°, with inclination usually to the north-west. Heavy outcrops are frequent, and several of the stronger veins are readily traced for distances of a mile and more. Structurally the veins are simple; branches are few and unimportant; faulting is normal and of but slight displacement. Zones of brecciation and sheeting are occasional, with incomplete replacement of wall-rock by auriferous quartz; but as a rule walls are fairly well defined and carry a thin selvage, heavy gouge being uncommon. Wall-rock has undergone silicification and pyritization, and alteration of the immediate country-rock is general. The gangue mineral is quartz; veinlets of secondary calcite are numerous and

rhodochrosite occurs in thin seams; mixed carbonates of iron, calcium, and magnesium are sparingly present and oxides of iron-manganese are abundant; pyromorphite occurs occasionally. The sulphides are pyrite, marcasite, chalcopyrite, galena, and sphalerite, and, very rarely, bornite, they occur massive, in banded form and in scattered bunches. Gold and silver, in a finely divided state, are associated with all sulphides, but evince a more pronounced affinity for sphalerite and galena. Visible gold is rare, and no silver minerals have been noted. Distribution of the sulphides is irregular, likewise the quantity of gold and silver which they carry. As a rule they follow one or both walls, the remaining section of the vein being composed of more or less barren quartz and silicified andesite. In the wider portions, however, it is not unusual to find a third streak in the body of the vein.

The orebodies show characteristic changes downward. A leached outcrop is followed by a rich oxidized zone which graduates into enriched sulphide ore, underlain by lean primary sulphides. Oxidation and secondary enrichment have proceeded irregularly, leaving no distinct lines of zonal demarcation.

Ore-shoots are persistent in length. That of the Vesuvius vein has been worked over a distance of 2500 ft.; of the Lone Star, 2400 ft.; of the Nightingale, 750 ft.; and of the Bonanza, 2000 ft. The Neptune, Venus, Mars, Pioneer, and Comal veins are as yet undeveloped; but sampling, at and near the surface, indicates a like habit. In depth the shoots average less than 200 ft., profitable ore being limited to those portions of the veins which have undergone alteration and secondary enrichment.

The value of gold content of ore-shoots in the major veins varies from \$3 to \$10 per ton, with a probable average of \$5 for the 12 veins which have been explored. Ore produced by the six veins mined, has averaged between \$7 and \$8 per ton. Occasional rich bunches have been encountered, running as high as \$60. No separate record has been kept of silver content.

Veins occupying the minor fissures, although exhibiting dissimilarity among themselves, collectively form a group type, distinct in some respects from that described. Outcrops are neither frequent nor strong, the veins generally being hidden beneath an overburden of clay, except where exposed in ravines and creek beds. Strikes conform to no general course, and a like diversity attends degree and direction of dip. They intersect and join one another, are comparatively short, and terminate by splitting into diminishing sections.

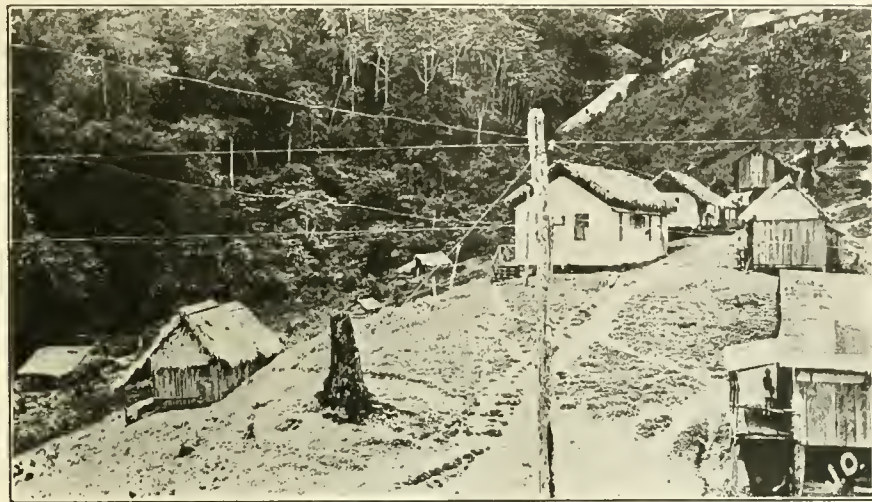
Mine openings permit of the examination of two such veins, and shallow prospecting has exposed a half dozen more in places. Width varies from 2 to 10 ft. with an average of about 4 ft. Stringers are numerous, but branch veins are rare. Post-mineral faulting is general but not severe. Walls are well defined except where destroyed by occasional fractured or brecciated zones. In places one wall is smooth and slickensided, the other is broken by innumerable imbricating cracks and fissures. Heavy gouge, found only in shattered areas, is due to

decomposition rather than to grinding movement. Silicification and pyritization of wall-rock and alteration of the adjacent country, are general and are more pronounced and extensive in the vicinity of fractures, crossings, and junctions.

Vein filling consists of quartz and silicified andesite. Veinlets of calcite are common; rhodochrosite occurs in thin seams; mixed carbonates of iron, calcium, and magnesium are present, and oxides of iron and manganese are plentiful. The sulphides are pyrite, marcasite, chalcopyrite, sphalerite, and galena. Gold and silver, in a state of fine division, occur with all sulphides, but favor sphalerite and galena. So minute are the gold particles that ore assaying \$30 per ton yields not even a color in the pan. Visible gold is said to have been found in former surface workings but none is now in evidence. A fairly representative sample of ore, assayed for gold, silver, zinc, and lead, returned gold, 0.45 oz. per ton; silver, 0.98 oz.; zinc, 1.31%; and lead 0.12%. Crystallization of the sulphides ranges from fairly coarse to very fine. They occur massive, intertwined, banded, in wave-like seams, and in scattered bunches, and generally follow one or the other wall, except in richer shoots, where the entire vein is mineralized. In such places the ore has become intensely hard and compact through re-cementation, and is frozen to the walls. The ratio of gold to silver is subject to wide variation, with a general average of one to two by weight. Their distribution in the sulphides is extremely irregular and limits of profitable ore can be determined only by assay. Variation in gold content is so great that orebodies can hardly be regarded as continuous shoots, being made up of bunches and streaks of richer ore, surrounded by and alternating with low-grade material. Intensified mineralization with increased gold content is occasional in the vicinity of minor faults, vein crossings, and junctions.

As with the major veins, change in character of orebodies from surface downward, corresponds to an imperfect zonal arrangement with extremely irregular divisional lines. The leached capping extends downward but a few feet; the zone of incomplete oxidation averages 50 ft. in depth; that of sulphide enrichment with augmented gold content ranges from 100 to 200 ft. in vertical extent. Beneath comes the primary ore, possessing no economic value. The occurrence of profitable ore is confined to the zone of alteration, but so irregular has been the downward progress of oxidation and enrichment that much lean ore is necessarily included within the general limits of the shoots. The shoot in the Eden vein is approximately 500 ft. in length, with an average width of 5 ft. The centre lies directly beneath a ravine where the vein has been eroded by a crossing stream. The lower limit roughly parallels the present surface contour, at an average depth of 200 ft., beneath which transition from secondary to primary ore is marked by an abrupt drop from \$12 to less than \$1 in the average value of gold content per ton. The shoot has produced some 30,000 tons of ore averaging \$14 per ton, and it is estimated that

there remains 18,000 tons averaging \$12. The Culebra shoot is marked by intermittent croppings extending up a steep hillside. Length is approximately 1000 ft., with an average depth of 250 ft. and an average width of 4 ft. Here also the lower limit is more or less parallel to surface contour except at the eastern extremity, in the vicin-



A GLIMPSE OF THE EDEN CAMP

ity of a cross vein, where a wedge-like extension reaches to a depth of 500 ft. About 24,000 tons of ore has been mined, averaging \$12 per ton. The remaining tonnage is estimated at 84,000, averaging \$11 per ton.

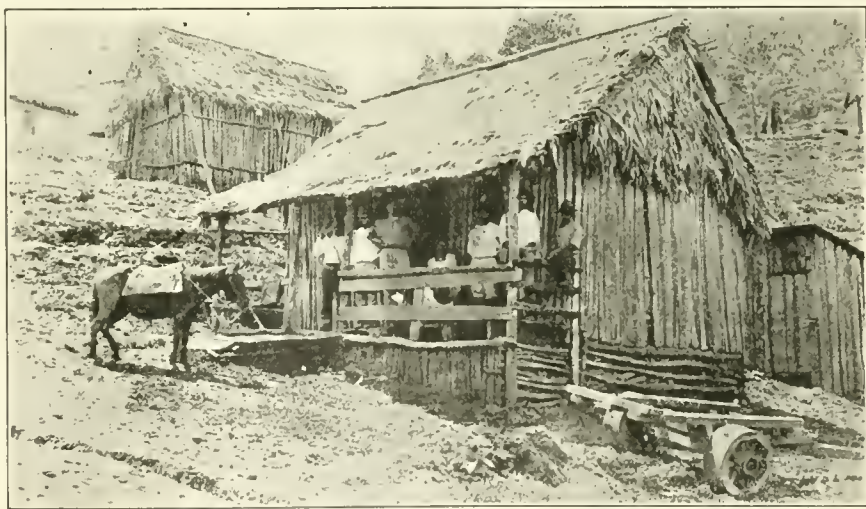
A characteristic feature of Piz Piz ore-shoots is their occurrence only beneath those portions of veins which either outcrop or carry but a scant covering of earth. In such there is a continuous downward movement of water along fractures, the volume of which varies with rainfall. Ground-water level is generally shallow and probably nowhere exceeds 200 ft. in depth. Where effectively sealed at surface by a capping of impervious clay, the veins beneath are comparatively dry, primary sulphides predominate and no ore of value is found.

Structural and mineralogical features of the two groups of deposits lead to the conclusion that they are of contemporaneous origin and identical genesis. Physiographic relations indicate that the present surface of the district is not more than 1000 or 2000 ft. below that existing at the time of vein formation. The veins are probably of late Tertiary age and were formed at shallow depth, by hot solutions, rising on fissures, subsequent to a period of igneous activity. Depositing solutions were weak in gold, and metallic sulphides and primary ores are consistently lean throughout. The existence of shallow bodies of ore of higher grade is due to concentration of gold by processes of oxidation and secondary enrich-

ment, the scope of which has been surficial. In this connection, the manganiiferous character of the deposits and the absence of placers are significant features.

Tales of gold in the upper courses of the Piz Piz were first brought to Cape Gracias by rubber-gatherers, who in former times ranged the forests of the Wanks river and its tributaries. Prospecting resulted in the discovery of no placers of consequence, but attention was attracted by the size and number of quartz outcrops encountered. Lode mining followed, and by the year 1901 five mines were in operation. From the opening of the district to the year 1916 mining was largely confined to the oxidized portions of the veins which yielded a comparatively soft ore, free-milling in part. As workings deepened the proportion of sulphides increased, necessitating recovery by cyanidation. Plants were installed; but the mills were unsuited to reduction of the harder ore; and low extraction, increased treatment costs, and steady decrease in grade of ore, combined

to render operations unprofitable. The close of the year 1916 witnessed the exhaustion of oxidized ores, and production of gold ceased for the time being. During this period the principal operating mines were the Siempre Viva, Constancia, Lone Star, Bonanza, and



TYPICAL HOUSE OF THE PIZ PIZ DISTRICT

Concordia. Their beginnings were similar; they were first worked in a small way by individual owners; profits were re-invested in additional plant, and the scale of operations gradually increased until by 1916 their total combined production approximated \$7,000,000. The mines were opened by adits. Hydro-electric or water power was developed on near-by streams. Ore was crushed under stamps or in Huntington mills. Pulp was run over amalgamating plates, sands leached by cyanide, and slime run to waste. Recovery by amalgamation averaged

50%, with an additional 10% from leaching of sands, so that 10% was lost in slime and tailing. The early operators were Americans and Canadians whose energy, pluck, and perseverance, in the face of unfavorable conditions, have not been rivaled in the annals of pioneer mining.

In a general way the history of one property reflects the story of all. The Lone Star vein was discovered in 1901 by the late William H. Bluett, of Toluimne, California, an old Mother Lode miner. In association with Norman McInness and George W. Smith, he opened the mine by a 200-ft. adit, cross-cutting the vein at a depth of 120 ft. A 3½-ft. Huntington mill, driven by a Pelton wheel, was set up and operated for 14 months, from May 1902 to July 1903, crushing 5600 tons of ore from which \$85,299.17 was recovered by amalgamation. Recovery estimated at 50% would indicate \$30 heads; the tailing ran to waste. A 20-stamp mill, with 550-lb. stamps, was installed from profits realized. The stamps were started in July 1903, and in a period of 26 months, to August 1905, 39,000 tons was crushed, yielding \$237,349.17 by plate amalgamation, equivalent to \$6.08 per ton. Recovery, estimated at 50%, indicated \$12 heads; the tailing ran to waste. A cyanide sand-leaching plant was then added, and during 41 months, from August 1905 to December 1908, 68,043 tons was milled, yielded \$313,778.73, or \$4.61 per ton. Recovery, estimated at 66%, indicated \$7 heads. The sand was leached and the slime wasted. Ten additional stamps, of 850 lb., were installed, and the mill operated for eight years, crushing 147,354 tons of ore which yielded bullion to the value of \$662,291.52, or \$4.49 per ton. Recovery, estimated at 64%, indicated \$7 heads. The sand was treated, the slime wasted. During 1916 slime-agitation and Butters filtration plants were installed.

A summary of operations for the 14½ years, ending December 1916 is as follows:

Veins	Length worked, ft.	Average width, ft.	Average backs, ft.	Tonnage mined	Surface ores, tonnage	Total tonnage milled
Lone Star	2400	7.4	83.6	146,788	4136	150,924
Nightingale	750	12.1	157.0	109,076	....	109,076
Total	3150	8.5	101.0	255,864	4136	260,000
Ore milled, tons						260,000
Average recovery, per cent						60
Bullion produced						\$1,293,357.64
Loss in tailing						862,238.42
Value of ore milled						2,155,596.06
Operating cost						908,557.64
Additional plant and improvements						271,437.81
Total cost						1,179,995.48
Net profit						113,362.16
						Per ton \$1.97

During the same period the Bonanza mine yielded slightly better results, the Siempre Viva and Constanacia did not fare so well, and attempts to work the Mars and Panama ended in failure.

With the exhaustion of oxidized ore in 1916, mining in the district came to a standstill. The Bonanza and Lone Star suspended operation; the Siempre Viva and Constanacia properties were combined and incorporated as the Constanacia Consolidated, with a paid-up capital of \$400,000. For treatment of the sulphide ores a 100-ton mill was installed, of 15 stamps, 2 tube-mills, and cyanide

plant. This has been in continuous operation since the middle of 1917 upon ore averaging between \$8 and \$10 per ton. Notwithstanding capable and economical management operating income has barely sufficed to cover expenses, no ore reserve has been developed, and no profit earned.

In 1915 the Eden Mining Co., with a paid-up capital of \$1,000,000, was organized as a subsidiary of the Tonopah Mining Co. of Nevada, to take over a group of claims adjoining the Bonanza ground to the north-east. The property covered about 12 veins in all, situated in the north-eastern extremity of the district. The former owner, the Panama Mining Co., had been unsuccessful in its operations, and the only development of promise was a shoot in the Eden vein, which had been opened to a depth of 250 ft. Following acquisition by the Eden Mining Co., a second shoot was discovered in the near-by Culebra vein, and interest thenceforth centred upon the two.

In recognizing the Eden and Culebra as belonging to the group of minor veins, hitherto unworked in the district, it was apparently assumed that their orebodies differed radically from those of the larger veins in the neighboring mines. The high-grade sulphide ore, immediately underlying the shallow oxidized zone, was classed as primary; and, as such, persistence in depth, without marked decrease in gold content, was taken for granted. Based upon this premise, a working plan was adopted which limited development in the upper levels to determination of length of shoots only, and provided for the driving of a haulage adit, 4000 ft. in length, designed to cut the two orebodies at a depth of 600 ft. At the time the property was acquired by the Eden Mining Co., ore in sight was estimated at 35,000 tons averaging \$18 per ton. Notwithstanding this very limited tonnage of incompletely proved ore, it was decided to proceed at once with equipment for operation. Construction was commenced in the latter part of 1915, and finished in December 1918. Equipment is complete in every particular but its cost has been entirely out of proportion to the ore resources of the mine.

For the handling of freight, a line of gasoline tow-boats and barges was established on the river, with warehouses and landings at Prinzapolea, Tunky, and Miranda, the last point being connected with the mine by six miles of tramway operated by gasoline locomotive. A wireless station was erected at the mine, providing communication with New Orleans. Power was developed by a 1000-kva. hydro-electric plant on the Piz Piz river, delivering current over a five-mile transmission line. The mill is of the conventional all-sliming cyanide type, in which the principal steps are coarse crushing, fine crushing, two-stage ball-milling in solution, mechanical and air agitation, filtration, zinc-shaving precipitation, and melting. Equipment includes Blake-type crushers, ball and tube-mills, Dorr classifier, agitators, and settlers, and Osgood filters. Originally designed for a daily capacity of 100 tons, recent additions are expected to increase this to 130. The mine equipment includes an 1800-cu. ft. compressor

SUMMARY OF MILL OPERATION 1919

Month	Tons milled	Percentage of time running	Tons milled per day	Value of gold recovered for month	Value of gold recovered per ton	Gold value of tailing	Gold value of head computed from production plus tailing	Extraction of gold %	Price of silver per ounce	Value of silver recovered per ton	Total value of gold and silver recovered per month	Total value of gold and silver recovered per ton
January	2,080	76.0	86.5	\$40,955.51	\$15.28	\$0.89	\$16.17	94.5	\$1.00	\$0.81	\$43,122.90	\$16.09
February	2,867	87.2	102.3	37,185.09	12.97	0.76	13.73	94.5	1.00	0.85	39,638.02	13.82
March	3,625	94.2	116.9	38,476.27	10.61	0.61	11.22	94.6	1.00	0.90	41,735.13	11.51
April	2,643	87.3	88.0	32,399.74	12.26	0.44	12.70	96.5	1.00	0.62	34,049.76	12.88
May	2,441	81.9	78.7	31,456.62	12.89	0.59	13.48	95.6	1.00	0.63	33,002.98	13.52
June	3,231	91.3	107.7	39,373.14	12.19	0.68	12.87	94.7	1.10	0.88	42,229.46	13.07
July	3,111	86.6	100.3	40,785.94	13.11	0.91	14.02	93.5	1.10	0.84	43,407.20	13.95
August	3,122	91.9	100.7	37,670.09	12.07	0.76	12.83	94.1	1.10	0.72	39,914.44	12.79
September	3,350	95.3	111.7	36,147.80	10.79	0.71	11.50	93.8	1.10	0.65	38,330.01	11.44
October	3,106	94.6	100.2	26,759.40	8.61	0.59	9.20	93.6	1.10	0.59	28,693.98	9.23
November	2,829	89.4	94.3	26,602.03	9.40	0.62	10.02	93.8	1.10	0.63	28,380.14	10.03
December	3,154	90.4	101.7	28,872.20	9.15	0.53	9.68	94.5	1.10	0.64	30,895.74	9.79
Year	36,159	88.9	99.1	\$416,683.83	\$11.53	\$0.67	\$12.20	94.5	\$1.583	\$0.74	\$443,339.76	\$12.27

plant. Water-Leyner, Waugh, and Jackhamer drills, and power sharpeners. Electric traction, by trolley locomotive, handles ore through the haulage adit and to the mill.

During the construction period the plan of underground development was carried out, and the mine prepared for shrinkage stoping. The Eden and Culebra veins were opened by a series of adits, the lower of which was connected by ore-chutes with the haulage level, 300 ft. below.

The results of mine development were most unsatisfactory with respect both to tonnage and grade of ore. The average depth of the Eden and Culebra orebodies was found to be little more than 200 ft., beneath which the veins continued fairly strong but greatly impoverished. At a depth of 600 ft., to which it had been confidently expected the shoots would extend, the average value of gold found was less than \$5 per ton. Despite negative results attained at depth in the Eden and Culebra veins, it was decided to continue the haulage adit 2000 ft. farther to the westward to cut the Hidden Treasure vein at a depth of 700 ft., and this is the one development working at present in progress. Surficial indications and topographic environment of the Hidden Treasure exposure give promise of an orebody similar in size and grade to that of the Eden. That its depth will exceed the usual 200 ft. or so, is highly improbable.

At close of the development period, footage of mine workings totaled 19,276, distributed as follows:

Vein	Elevation above sea-		Cross-cuts,	Raises,	Winzes,	Total,
	Level No.	level, ft.				
Eden	1	1193	50	367	60	477
Eden	2	1126	118	155	55	328
Eden	3	1016	1388	435	650	2494
Culebra	1	1083	1381	220	1425	3026
Culebra	2	940	1980	215	2205	4400
Nugget	1	1012	500	100	....	600
Taboiba	1	1050	327	80	....	407
Hidden Treasure	1	1199	1000	119	....	1119
Haulage level	....	625	5025	....	1400	6425
			11,769	1691	5804	12 19,276

Estimate of ore developed by the foregoing was as follows:

Vein	Tons	Average assay value gold	Value of gold content
Eden	17,624	\$16.69	\$294,075.60
Culebra	82,993	11.73	973,799.84
Hidden Treasure	12,467	12.38	154,348.58
	113,084	\$12.57	\$1,422,224.02

To which should be added 19,000 tons averaging \$14, which was milled during development.

At close of the construction and development period, or up to December 31, 1918, expenditure upon the property amounted to \$2,215,627.92.

Milling was commenced in November 1918, and has since been continuous. During 1919, the first year of production, the results of the company's operations were as follows:

Ore milled, tons	36,159
Extraction of gold, per cent.	94.5
Production:	Per ton
Gold produced	\$416,683.83
Silver produced	21,715.93
	0.74
Total bullion	\$438,399.76
Lost in tailing	24,416.56
	0.67
Total value ore milled	\$462,816.32
Income:	
Income from bullion	\$438,399.76
Other income	8,547.84
	0.23
Gross income	\$446,947.60
Operating expense:	
Cost of mining	\$161,272.09
Cost of milling	130,822.47
Indirect mining and milling cost	44,706.04
Marketing bullion	23,581.89
	0.652
Direct operating expense	\$360,382.49
Indirect expense and fixed charges:	
Administration expense	\$ 18,000.00
General expense	10,403.73
Taxes	1,169.50
Depletion	58,859.30
Depreciation	24,142.12
Interest	131,250.66
	3.629
Total expense	\$604,207.80
Net loss for year	152,260.20
Decrease in average value per ton of ore milled	4.21
Decrease in average value per ton of ore-reserve	\$6.66
Decrease in gold content of ore-reserve	1.16
	\$109,452.40

Development amounted to 2247 ft., bringing total footage of mine workings up to 21,523. The limits of the Culebra and Eden shoots were established. No new orebodies were discovered. At the close of the operating year the ore-reserve was estimated at 115,161 tons, with an average gold assay value of \$11.41 per ton, or a total gold content of \$1,313,770.62. Allowing for the usual 10% discrepancy between estimated value of ore sampled in place and actual value of mill-heads, and for an extraction of 94.5%, the recoverable gold content of ore-reserve is \$1,117,361.97 or \$9.70 per ton as against a direct operating cost of \$9.97 per ton and a total charge of \$16.71 per ton.

COST OF POWER

30,048 kwh hours delivered during the year		Plant		Transmission line		Total	
District		per kw hour		per kw hour		per kw hour	
Labor	\$ 7,800.10	\$0.0030	\$1,077.00	\$0.0005	\$0.847.80	\$0.0035	
Supplies	2,011.17	0.00060	801.04	0.00050	812.21	0.00062	
Repairs	1,188.87	0.00049	870.03	0.00050	950.50	0.00068	
Total	\$11,000.90	\$0.00305	\$3,040.00	\$0.00120	\$14,715.53	\$0.00485	

COST OF DEVELOPMENT

Distribution	Drifts per ft	Crosscuts per ft	Raises per ft	Winzes per ft
Superintendence and labor	\$0.70	\$0.04	\$8.20	\$11.08
Explosives	3.89	4.05	2.80	4.00
Supplies	2.40	1.50	1.02	2.00
Power	1.44	0.80	0.52	1.48
Total cost	\$17.52	\$14.25	\$12.00	\$20.58
Footage	1057.5	501.4	534.0	03.5

COST OF MINING 30,150 TONS

Item	Total quantity	Total cost	Quantity per ton	Cost per ton	Percentage of cost
Labor		\$84,068.88		\$2.35	52.11
Power		7,093.58		0.197	4.42
Dynamite	92,138 lb.	29,824.01	2.55 lb.	0.825	18.49
Fuse	403,070 ft	3,689.84	1.03 ft	0.102	2.29
Caps	80,110	1,572.00	2.2	0.045	0.99
Candles	10,167 lb.	4,184.33	0.45 lb.	0.110	2.41
Carbide	4,435 lb.	609.28	0.12 lb.	0.018	0.41
Drill steel	23,545 lb.	5,424.20	0.65 lb.	0.150	3.30
Timbers		3,129.07		0.087	1.95
Charcoal	40,000 lb.	4,380.40	1.11	0.121	2.71
Assay supplies		658.70		0.018	0.40
Compressor supplies		896.44		0.025	0.56
Tramming		3,545.47		0.098	2.20
Miscellaneous		12,159.00		0.330	7.53
Total		\$101,272.00		\$4.461	100.00

COST OF MILLING 36,150 TONS

Items	Supplies consumed	Cost	Consumed per ton	Cost per ton	% of cost
Superintendence		\$5,425.42		0.150	4.10
Operating labor		12,901.88		0.357	9.88
Repair labor		4,435.12		0.123	3.38
Power		11,298.52		0.312	8.62
Crusher parts		667.68		0.018	0.48
Conveyor-belt		938.91		0.026	0.73
Ball and tube-mill parts		941.37		0.026	0.73
Mill liners	19,421 lb.	7,986.90	0.54 lb.	0.221	6.11
5-in. balls	59,380 "	7,505.30	1.64 "	0.207	5.72
2 1/2-in. balls	70,817 "	9,443.67	1.90 "	0.261	7.22
Cyanide	93,400 "	34,812.48	2.58 "	0.963	26.62
Lime	252,898 "	14,993.88	0.69 "	0.415	11.47
Zinc	30,000 "	7,437.40	0.83 "	0.205	5.67
Acid	65 carboys	931.23		0.026	0.73
Grease	4,860 lb.	910.98	0.13 "	0.025	0.73
Oil	550 gal.	365.95	0.02 gal.	0.010	0.28
Borax	5,155 lb.	1,071.00	0.14 lb.	0.030	0.78
Soda	3,280 "	360.80	0.09 "	0.010	0.28
Crucibles	15	933.03		0.026	0.73
Crude oil	1,900 gal.	951.30		0.027	0.73
Canvas	165 yd.	578.60		0.016	0.45
Pump repair parts		345.53		0.010	0.28
Miscellaneous		5,585.11		0.154	4.22
Total		\$130,822.47		\$3.618	100.00

INDIRECT EXPENSE

Item	Cost per ton
General superintendence	\$ 4,445.52
Office expense	4,046.21
Warehouse	2,013.22
Legal expense	3,465.16
General expense	20,835.90
Total	\$44,706.04
	\$1.236

On January 1, 1920, the property represented an investment of \$2,641,642.47. Redemption of this capital would require 20 years, and 1,000,000 tons of \$18 ore. The existence of such an orebody or of an approximation thereto within the company's holdings, or, for that matter, in the entire district, is without the realm of possibility. The Eden Mining Co. was foredoomed to disaster at its inception, through failure either to recognize the surficial nature of the Piz Piz deposit, or to investigate persistence in depth before proceeding with heavy expenditure in equipment.

Operating details and costs at the Eden are of interest, as being the only records of the kind in the district covering the mining and milling of sulphide ore.

Undeterred by the failure of the Eden and Constancia to extract profit from sulphide ores, the Nicaragua Mining Co. was organized in Philadelphia in 1919, to acquire the Lone Star, Bonanza, Mars, and Concordia mines. Development work was commenced early in 1920, and it is proposed to resume milling as soon as mines and mills have been put in condition. In addition, the Neptune vein, which forms part of the Bonanza property, is being developed, and a new mill is under construction for the treatment of this ore. The installation will include nine Hendy stamps of 1100 lb. each, with individual mortars, two Huntington mills, an Akins classifier, and a cyanide plant. Ore is to be crushed to $\frac{1}{4}$ mesh, under stamps, and further reduced in Huntingtons. Sand and slime are to be treated separately.

Conditions in the district today are unfavorable to a continuation of mining. The known bodies of profitable free-milling ores have been exhausted, and the thorough prospecting of the lode which has been made renders improbable any further discoveries of this nature. There remains a large but undetermined amount of sulphide ore, varying in gold content from \$1 to \$5 per ton, which cannot be worked at a profit. The few shoots of high-grade sulphides are too limited in extent to constitute mines within themselves. Authentic data are not available, but a general review of the district leads to the conclusion that during its 20 years history the total expenditure has equaled, if not exceeded, the value of bullion produced.

Mexican Metal Production

Figures showing the production of metals and minerals in Mexico for the years 1917 to 1920 have been prepared by the Mexican Secretariat of Industry, Commerce, and Labor, and are quoted in a consular report of recent date. The following table is submitted with the comment that the figures for 1920 are of a preliminary nature and subject to later rectification:

	Years			
	1917 kilo.	1918 kilo.	1919 kilo.	1920 kilo.
Gold	23,542	25,313	23,586	23,370
Silver	1,300,988	1,944,542	2,049,808	1,979,972
Copper	50,985,923	70,223,455	56,172,235	46,056,000
Lead	64,124,752	98,837,154	71,375,908	121,434,066
Zinc	45,180,778	20,698,996	11,559,085	14,363,657
Mercury	33,132	163,597	118,040	77,229
	Years			
	1917 kilo.	1918 kilo.	1919 kilo.	1920 kilo.
Antimony	2,640,544	3,278,546	470,738	1,572,376
Graphite	420,046	6,190,849	4,023,015	2,991,529
Tungsten	187,637	149,486	21,970	34,917
Tin	9,214	13,538	1,588	
Arsenic	1,284,820	1,881,011	2,246,378	1,198,806
Manzanese	73,387	2,878,383	2,294,227	838,624
Molybdenum		27,371	1,767	648

The Standardization of Mining and Milling Materials

By E. A. Wraight

*During the last few years great progress has been effected in the standardization of materials employed in general engineering practice; but with one exception, no combined or individual effort appears to have been made to formulate a standard specification for any class of material employed in mining or milling.

Attention has been drawn at rare intervals to this lack of enterprise on the part of mining engineers, but the only really determined effort to collect the necessary data and to draw up a specification, appears to have been effected by the South African 'Mines Trials Committee'. This body issued a report in 1912 following "an investigation by Robert Allen on various kinds of rock-drill steel for the purpose of determining the most suitable steel for use on the Rand and the standardization of its heat-treatment". With the issue of this report the matter apparently ended.

Manufacturers of the various appliances used in mining and milling, with very few exceptions, seem singularly reluctant to impart any information with regard to the analyses and tests they employ, and I have found it almost impossible to collect any data from this source. Moreover, very few complete records ever appear to have been taken on the actual plant, and with the exception already mentioned, analyses are completely ignored.

Algernon Del Mar¹ drew attention to these facts in a short paper, dealing with cam-shaft failures, in the following sentences:

"The only practical method of determining material is to keep accurate records of its performance, its chemical composition and physical properties; and when such data are collected and compared for many cases, we may be able to form correct conclusions.

"I would propose that some Society interested in stamp-milling operations receive for exhibit and analyses, samples of broken cam-shafts, the sender to furnish all available data thereto, such as the diameter of the shaft, number of stamps, height of drop, number of drops per minute, number of stamp-hours the shaft has been in use before breaking, and from which part of the shaft the sample was taken.

"It is about time for us to get into line with scientific engineers and not stay in the hit-or-miss class."

The last sentence should appeal to every manufacturer, and to every engineer using mining or milling machinery. Work has already been done, but much more remains to be accomplished, and the following notes are submitted in order to draw attention to the need for the co-ordination of results, the compiling of accurate data, and the standardization of specifications.

DRILL-STEELS

Drill-steels, on which the greatest amount of investigation appears to have been effected, will be first considered, and at this stage it is desirable to summarize very briefly the report of the Mines Selection Committee.

On the results obtained from the 38 steels tested by Robert Allen the following conclusions were reached:

1. There is no practical difference in open-hearth, Swedish-bessemer, electric, or crucible steel, provided they are of the same composition.

2. Alloy steels are not so satisfactory as carbon steels provided the composition of the latter is in accordance with the figures given below:

Drills over 1 1/2 in. diam.	C 0.60 to 0.65%	Si, 0.05 to 0.15%
1 1/2 in. "	C 0.64 to 0.69%	S and P, 0.35% together
1 in. "	C 0.67 to 0.72%	Mn, 0.25 to 0.35%
3/4 in. "	C 0.70 to 0.75%	(Mn + Si, not over 0.40%)

Aluminum may be allowed up to 0.10%.

3. Steels which gave the best results on test had the following composition:

Drills 1 1/2 in. diam.	C .....0.66%
	Si .....0.09
	S and P.....0.036 (together)
	Mn .....0.28
Drills 1 in. diam.	C .....0.69%
	Si .....0.09
	S and P.....0.036 (together)
	Mn .....0.30
Drills 3/4 in. diam.	C .....0.72%
	Si .....0.09
	S and P.....0.035 (together)
	Mn .....0.27

The report further states that when using large bits on 1 1/2-in. diameter drills there is a danger of de-carburizing the wings, and that such bits are difficult to harden properly, unless the carbon content is moderate—0.60 to 0.65% being suggested as the desirable limits. The presence of sulphur and phosphorus is condemned, and the limit for the total of these elements is fixed at 0.045%. Above this figure 'flaking' occurs, and 'cutting off' during sharpening becomes necessary.

4. Octagonal bars of the same steel made by hammering or rolling are equally efficient.

With regard to these various deductions, I am in agreement with the first statement. Provided that steels are of exactly identical composition, there is no valid reason why steel made in the acid open-hearth furnace should not be equally efficient as steel produced in the crucible. Unfortunately, however, from the financial point of view, steels made in the open-hearth furnace are rarely if ever as pure as the electric or crucible product, and the latter class of material therefore naturally commands a considerably higher price.

Two of the chief essentials for a good drill-steel are that it shall have a low manganese content and a minimum of sulphur and phosphorus. The last-mentioned elements are as much an enemy to the drillman as to the

*Abstracted from Bulletin 196, I. M. M.

¹'Min. & Eng. World', April, 1914.

constructional engineer, and if present in appreciable percentage are liable to cause flaking, cracking, and fracture. A combination of much carbon and manganese is detrimental to the life of a drill, and many cases of failure can be traced directly to this cause. The presence of slag and other inclusions has led to innumerable fractures, not only in drills, but in all classes of steel used for engineering purposes.

The question now arises as to what shall constitute a desirable specification. One suggestion is as follows:

	%
C	0.85 to 0.90
Si	0.1 " 0.2
S	0.03
P	0.03
Mn	0.3 to 0.4

The central hole to be of the following dimensions:

Diam. of drill	Minimum diam.	Maximum diam. of hole
$\frac{1}{4}$ in.	$\frac{1}{4}$ in.	$\frac{5}{16}$ in.
1 " "	$\frac{3}{8}$ " "	$\frac{11}{16}$ " "
1 $\frac{1}{2}$ " "	$\frac{1}{2}$ " "	$\frac{5}{8}$ " "

and to be of such a size and shape that a steel ball equal in diameter to that of the minimum diameter of the hole, will pass completely through the bars. If the hole is elliptical the long diameter must not exceed the short diameter by more than $\frac{1}{16}$ in., and the hole must not be more than $\frac{1}{32}$ in. off centre from the axis of the bar. Seams and flaws will result in the rejection of the bars, which must be within the limits ± 1.64 in. on the finished size diameter. It would be interesting to learn how many drills at present in use would comply with these requirements, especially with regard to the eccentricity of the hole!

One Sheffield specification for hollow-steel drills from 1 to 1 $\frac{1}{4}$ -in. diam. is as follows:

	%
C	0.75 to 0.80
Si	up " 0.20
S	not exceeding 0.02
P	" " 0.02
Mn	" " 0.3

These figures may be contrasted with the analysis obtained on a German hollow drill captured early in 1918:

	%
C	0.53
Si	0.09
S	0.044
P	0.048
Mn	0.80
Ni	0.07

The following analyses, made from samples of hollow drill steels 'as delivered', show how the composition may vary; and is an indication of the desirability, if not the necessity, for standardization:

	1	2	3	4	5
	%	%	%	%	%
C	0.50	0.62	0.65	0.79	0.78
Si	0.12	0.10	0.10	0.03	0.18
S	0.048	0.045	0.043	0.038	0.018
P	0.050	0.044	0.044	0.007	0.010
Mn	0.37	0.36	0.41	0.23	0.32

All these steels except No. 5 were 1 in. diam., the latter being 1 $\frac{1}{4}$ in. The variation shown in the carbon and manganese on three samples from one batch of 1 in. drills, which all fractured underground, further emphasizes the above remark.

	1	2	3
C	0.68%	0.72%	0.80%
Mn	0.21%	0.32%	0.31%

When considering a specification for drill steel the following points must be borne in mind:

1. The steel must be able to withstand percussive shock. Drills are frequently run at a speed of 1500 blows per minute, and the effect of rapidly-delivered strokes on a blunt drill in hard ground, where the cushioning effects of penetration are reduced to a minimum, can readily be imagined.

2. The drill must be sufficiently high in carbon content to resist bending, hence the necessity for a higher carbon steel, with consequent higher elastic limit, as the drill diminishes in diameter.

3. The steel must be capable of being completely hardened by quenching; and, as unskilled and native labor is frequently employed on this job, a steel capable of simple heat-treatment is very desirable.

4. The bit must keep its full cutting diameter when in operation, and must therefore resist abrasion, or 'loss of gauge' and 'stuck' drills will result.

5. The steel must not chip or flake when in action.

From a consideration of these points it would appear that for a straight carbon steel, the carbon content should be approximately 0.70% for the best all-round service on a 1-in. drill; the percentage to be raised by 0.05 per $\frac{1}{8}$ in. or lowered by 0.05 per $\frac{1}{4}$ in., according as to whether the diameter is diminished or increased. The silicon content is not a matter of the greatest importance, and the modern tendency of steel making is certainly in favor of a much higher percentage than would be tolerated a few years ago. About 0.1 or 0.2% will be found satisfactory. The presence of sulphur and phosphorus has an important bearing on the mechanical properties of drills; and the effects of the latter are intensified as the percentage of carbon increases. The less of these elements the better, 0.03% being regarded as the desirable top limit for each, although plenty of drill-steel has given good service when these amounts have been increased to 0.05%.

Manganese should not exceed 0.3% unless the carbon content is low; and a limit of 1% for Mn + C is suggested. I entirely disagree with the use of aluminum, and in no circumstances should a percentage of 0.1 be tolerated. The present tendency of Sheffield manufacturers is to dispense with its use, and ferro-silicon is now substituted as a killing agent with more satisfactory results.

A point which has hitherto been ignored is the formation in the hole in the drill. The bulk of the hollow drill-steel imported into this country is probably mandrel-rolled, whereas English-made drills are usually core-rolled. There seems to be little doubt that the latter method produces the best drill, as the circumfer-

ence of the central hole is less liable to surface cracks which may extend in service and ultimately cause breakage.

With regard to alloy steels there appears to be very few data to prove their advantages or disadvantages. Allen states that "such steels are not equal to the best carbon steels on account of their tendency to overheat and their lack of uniformity of composition". Further, he remarks that "the heat-treatment of chromium steels is not simple, and the drills are liable to deteriorate". Vanadium steels possess no advantage whatever over carbon steels and are more costly. Drills are better without tungsten, which renders the steel liable to crack on heating and imparts brittleness and difficulty in forging. Finally, Allen considers the fine grain of tungsten steel detrimental, as the finer the grain the less the resistance to drilling shocks.

On the other hand, Harbord² states that a small addition of tungsten has been found to improve the wearing properties of some classes of chisel steel. For example, a steel of the following composition gave good results for the working of pyrites, whereas a steel of similar composition without the $\frac{1}{4}\%$ addition of tungsten failed in a competitive trial:

	%
Fe	98.40
C	0.63
Si	0.126
Mn	0.522
S	0.006
P	0.034
W	0.241

A steel containing 0.57% C, 0.21% Si, and 0.325% W also stood this class of work well, where a higher-carbon steel without tungsten failed to do the work satisfactorily.

The only conclusion that can be drawn from these conflicting statements is that Allen must have been singularly unfortunate in his deliveries of alloy steels or else they must have been grossly maltreated. From theoretical considerations, it would appear probable that both chromium and tungsten steels would have considerable advantages in reaming efficiency and reduced attention. It is difficult to understand why such steels should be complicated in their heat-treatment. Forging, however, is probably slightly more difficult; and any tendency to brittleness might be accentuated. A promising field for research is opened at this point, and in the absence of comprehensive and comparative data it would be unwise to dogmatize.

STAMP-BATTERY PARTS

SHOES AND DIES. Materials in use for these parts are of many descriptions and varied in composition. Cast-iron was formerly much in favor, but at present is probably little used on account of rapid wear, and the difficulty of economically utilizing the scrap. Where a foundry is attached to the mill and 'ends' can be remelted and cast, cast-iron is probably the cheapest ma-

terial to employ. Both shoe and die require to be heavily chilled on the wearing surface, and a soft shank is very desirable on the shoe.

The chief requirements for shoes and dies are:

1. Resistance to abrasive wear.
2. A high capacity for withstanding impact.

With regard to the former, Jane³ states that at the Simmer Deep and Jupiter mines one 8-in. die (170 lb.) wore out two 15-in. shoes (300 lb. each). Whether this statement is typical of general practice is open to question, but in any case it is obvious that the shoe must be more subject to attrition than the die on account of the protecting layer of ore on the latter. Cast-iron has now been very largely replaced by forged or cast-steel, and considerable diversity of opinion exists as to the relative merits of shoes and dies when supplied as forgings or castings. In certain mills the former is preferred, whereas in others, slower and more even wear is claimed for the latter. As a result of certain investigations carried out at the Simmer & Jack mill, Dixon⁴ condemns the use of cast-steel shoes, and states that 10.9% of imported shoes broke at the shank, as against 3.5% of forgings.

An electric furnace was erected in South Africa for the purpose of re-melting and re-casting scrapped shoes and dies.⁵ The castings produced gave analyses within the following range:

	%
C	0.64 to 1.18
Si	0.12 " 0.35
S	0.02 " 0.06
P	0.02 " 0.07
Mn	0.35 " 0.67
Cr	0.02 " 0.20

From observations on the behavior of these shoes and dies in service it was found that 58% of the breakages were due to blown or honeycombed castings, and 29% of the failures could be attributed to the presence of an excess of carbon in the steel, 1.1% or more being found on analysis. With regard to alloy steels, certain conflicting statements have been made from time to time, and although it seems to be generally agreed that the presence of chromium (up to 0.5%) confers distinctly beneficial properties on forged-steel shoes, the influence of manganese may not prove so satisfactory. Del Mar⁶ cites a case in which manganese steel chipped off in chunks, indicating the presence of internal stresses.

In the absence of any knowledge relative to chemical composition and heat-treatment such facts are of comparatively little value. A reason can be found for practically every failure in a steel component, but until all data with regard to breakage and wear are collected it is obviously unwise to pass judgment. With the exception of Stanley's figures I can find no published analyses of the materials used for shoes and dies. Manufacturers of these parts have been approached on the subject and informed me that no standard analysis or specification exists,

³Jour. C. M. & M. S. of S. Africa', Feb., 1918.

⁴Jour. C. M. & M. S. of S. Africa', Apr., 1918.

⁵Stanley, 'Jour. C. M. & M. S. of S. Africa', Sept., 1917.

⁶Min. & Eng. World', 1914.

²'Metallurgy of Steel'. 1916 edition, p. 414.

hence the following data relative to wear, which have been selected for purposes of comparison, are not very enlightening:

Weight lost per ton of ore crushed	Lb.
Cast-iron shoes	1.5
Cast-iron dies	0.4 to 1.5
Cast-steel shoes	0.5 " 0.75
Cast-steel dies	0.3 " 0.70
Forged-steel shoes	0.30
Forged-steel dies	0.21
Chrome-steel shoes	0.29
Chrome-steel dies	0.16

No mention is made of the size to which the ore was crushed, nor the rate of crushing.

The standardization of material for shoes and dies is by no means easy, as various combinations to ensure even wear are possible. The cheapest combination irrespective of length of life is probably a cast-iron die and a forged or cast-steel shoe as employed on the Sons of Gwalia mine,⁷ while cast or forged steel shoes with dies of slightly lower carbon content might be employed economically. A chrome-steel shoe on a straight carbon die is suggestive of efficiency and is current practice on the Tonopah mill of the Belmont Milling Co. The finest combination for resistance to abrasive impact, with consequent long life and even wear, would probably be a manganese-steel shoe with a chrome, chrome-vanadium, or nickel-chrome die.

Before any attempt can be made to pronounce a definite decision on these matters, properly collected statistics are necessary, embodying the following points:

1. The nature of the ore; for it is obvious that any comparative tests would have to be made on the same class of ore.

2. Size of ore delivered by feeder.
3. Height of drop.
4. Drops per minute.
5. Size of screen.
6. Duty per stamp.
7. Weight of shoe and die when new.
8. Weight of shoe and die when scrapped.

In any case it is apparent that with the present cost of labor and excessive transport rates, length of life, and uniform wear are of paramount importance, and that what appears to be the most expensive steel may prove cheapest in the long run. The following analysis might be taken as a basis on which to form specifications for shoes and dies in cast or forged and manganese steel.

Cast or Forged Steel

	%
C	0.55 to 0.65
Si	up " 0.25
S	not more than 0.06
P	" " " 0.06
Mn	" " " 0.35
Cr	approximately 0.5

Manganese Steel

	%
C	0.9 to 1.1
Si	up " 0.5
Mn	11 " 13

S	not more than	%
P	" " "	0.10
Cr may be present up to a maximum of		0.5

With regard to nickel-chrome steels, there are many types in use for engineering work containing an average of 0.28 to 0.42% carbon, with nickel ranging from 1 to 3.75%, and chromium from 0.45 to 1%. Until such time as these steels have been tried in practical milling it would be unwise to attempt to formulate a specification for this class of material.

CAM SHAFTS. For cam-shafts, nickel-chrome steel would appear to be the ideal material and a good analysis is as follows:

	%
C	0.28 to 0.32
Si	up " 0.3
S	not over 0.04
P	" " " 0.04
Mn	0.35 to 0.45
Ni	3.25 " 3.75
Cr	0.55 " 0.65

Such a shaft, properly heat-treated, would give an ultimate stress of 60 tons per square inch and an impact value of not less than 40 ft.-lb. The suggested employment of nickel-chrome steel is by no means new or original. C. T. Hutchinson⁸ in 1911 strongly urged the adoption of this material for cam-shafts, and stated that a suitable steel for this purpose would show the following figures:

Ultimate stress	300,800 lb. per sq. in.
Yield	144,900 " " " "
Elongation	8 %
Reduced area	23 %

Refined, hammered, malleable iron is also claimed as the best material for cam-shafts, giving a minimum life of 2 and a maximum of 10 years. An obvious method for reducing breakages is to increase the factor of safety; but it must not be forgotten that an addition of 10% to the diameter of a shaft will result in an increase in weight of 21%. In view of modern practice such a proceeding therefore seems unnecessary, and the increased service that would be obtained from a nickel-chrome steel would undoubtedly compensate many times over for the higher initial cost. It must be remembered that the breakage of a cam-shaft is a serious item, and may put 5 or 10 stamps out of action for a long period.

CAMS AND TAPPETS. These items are usually cast. Chrome steel is stated to be satisfactory for this purpose, but I can find no records of analyses or other particulars. On theoretical grounds forged cams would certainly appear better than castings, and a good medium-carbon steel, with the addition of up to 0.5% chromium, would readily forge and possess the necessary wearing properties.

BATTERY-STEMS. Wrought Swedish iron or mild steel is commonly employed for these parts, and fractures are unusual. When a breakage does occur the fractured

⁷E. & M. J., 1916, p. 224.

⁸M. & S. P., Dec., 1911.

surface frequently exhibits a coarse crystalline structure which has been stated to be the effect of re-crystallization under repeated impact, but is much more probably due to the temperature being too high during rolling. The stresses in battery-stems are practically all in the direction of the grain, but stresses may occur consequent upon the shoe hitting unevenly-distributed ore, especially when either or both shoe and die are badly worn.

Mild steel of the following composition should prove satisfactory for ordinary service:

	%
C	0.15 to 0.25
Si	up " 0.15
S)	not over 0.06
P{	
Mn	up to 0.6

Disregarding cost, there is not doubt that a 3% nickel steel would be the ideal material to employ, and the stems when properly heat-treated should be practically everlasting.

Analysis:	%
C	0.20 to 0.30
Si	up " 0.25
S	0.04 top limit
P	0.04 " "
Mn	0.35 to 0.55
Ni	2.5 " 3.5

MORTAR-BOXES. These are usually made in cast-iron or cast-steel. I can find no figures whatever relative to analysis; and, as the former material is liable to vary in composition, standardization in this instance certainly seems desirable.

MORTAR-BOX LININGS. Many and various materials are in use for this purpose, from chilled cast-iron to manganese steel. Owing to the shortage of steel during the last few years, and the extreme difficulty in obtaining supplies, all kinds of makeshift liners were utilized from material that would otherwise have been scrapped, hence any results which have been published are scarcely typical of current practice. Manganese steel (13%) is stated to be an excellent material for this purpose. At the Nipissing mill the life of a chilled-iron mortar lining is given by Johnston⁹ as 30 days, a manganese-steel lining lasting no less than 165 days.

BATTERY-SCREENS. Extreme length of life is claimed for screens of high-carbon, steel-wire cloth, and such material is employed at the Nipissing mill,¹⁰ the screens being 18 in. deep and formed of double-crimped crucible-steel wire. Monel metal¹¹ is also stated to be excellent for the same purpose and to show no signs of corrosion. Further, this alloy is proof against amalgamation. The following would appear to be a desirable analysis for the former class of material:

	%
C	0.8 to 1.0
Si	up " 0.25
S)	0.04 ton limit
P{	
Mn	up to 0.5

⁹Bull. A. I. M. E., Jan., 1914.

¹⁰Bull. A. I. M. E., XLVIII, p. 13.

¹¹J. W. Neill, 'M. & S. P.', 1914, pp. 109, 839.

BATTERY FRAMES. In the complete absence of particulars with regard to battery frames, it is difficult to know whether any specification is desirable in this case.

As a matter of interest it may be mentioned that a cast-steel frame was erected at the Tightner mill, Alleghany, California,¹² in 1914, the main posts of which weighed 4500 lb. each. All cross-pieces were of cast-steel; and rigidity, together with small upkeep costs, was expected from this innovation.

ROLLS

The modern tendency is to increase the duty of rolls, and it has been suggested that this form of crushing will eventually supplant the stamp-battery.

Shells of chilled cast-iron and manganese steel have both been employed, and while giving a relatively long life have frequently to be scrapped as soon as they become coneave, owing to the extreme difficulty of 'facing'. Attempts have been made to overcome this objection by means of a 'traveling roll' and by the use of high-carbon, manganese, and chrome steels in the form of tires or plates bolted to a central mandrel.

For rolled-steel tires¹³ Ferguson gives the following analysis:

	%
C	0.65 to 0.80
Si	0.15 " 0.30
S	0.04
P	0.05
Mn	0.6 " 0.85

Such a steel will give mechanical tests as follows:

Ultimate stress	125,000 lb. per sq. in.
Elastic limit (yield) ..	72,000 " " "
Elongation	10 %
Reduced area	15 %

As a result of actual tests it was found that 1.06 lb. of steel made to the above specification was consumed per ton of rock crushed on one set of rolls, 4.25 lb. per ton on another, and 3.8 lb. per ton on a third set. The three sets of shells weighed 4494 lb. and the discard only 1640 lb. For a solid shell, chrome steel would in all probability give the most satisfactory all-round service, being relatively easily faced. Here again insufficient data are available, and more results of practical experience are required. Many conflicting statements appear from time to time and opinion seems to be summarized by Lay's statement¹⁴ that where the feed is 1½-in. size, manganese steel will have at least double the life of chrome steel. For fine crushing the advantage lies with the cheaper chrome steel.

BALLS FOR MILLS

The chief factor in the life of a ball is its ability to resist sliding abrasive attrition, and therefore the harder the surface of the steel the longer it will last in service. An exception must be made in the case of manganese steel. Manganese steel is soft under both Brinell and scleroscope tests and yet is reported to give excellent re-

¹²'M. & S. P.', 1914, pp. 108, 419.

¹³Bull. A. I. M. E., 1914, No. 93, p. 2333.

¹⁴D. Lay, 'E. & M. J.', 1916, pp. 101, 951.

suits both in the tube and Hardinge mills at Butte and Anaconda.¹⁵

For purposes of comparison, three analyses recently made on balls supplied from different sources are appended:

	%	%	%
C	0.84	1.17	1.21
Si	0.42	0.40	0.80
S	0.031	0.034	0.031
P	0.031	0.067	0.098
Cr	0.06	0.03	0.06
Mn	0.56	0.89	10.97
Wetness	3.5 mm.	3.3 mm.	4.1 mm.
Scleroscope	45	55	27

One objection to the use of manganese steels is the difficulty of obtaining perfectly sound castings on a large scale; and, therefore, balls of considerable diameter, unless forged, might not prove economical. Further, it should be noted that the beneficial properties are conferred upon manganese steel by suitable heat-treatment, and considerable difficulty exists in successfully treating large masses of this metal. Irrespective of expense, ball-race steel, which has the property of intense hardness, appears admirably suited for the purpose in question. Such a steel would have the following composition:

C	0.9 to 1.1
Si	up " 0.35
S	not more than 0.035 each
P	
Mn	0.25 to 0.50
Cr	1.2 " 1.7

The presence of nickel up to a maximum of 0.5% would be allowable. Relatively small balls could be utilized in the hardened condition, but the larger sizes (6 in. or more in diameter) are liable to fracture unless tempered. The heat-treatment to which this steel should, therefore, be subjected would be oil quenching from 760° to 780°C. (the exact temperature depending on the carbon and chromium), and tempering at about 460°C. Opinion is much at variance with regard to the life and wear of balls. Chrome steel is stated to be better than manganese steel, and vice versa; on account of low cost, cast-iron finds favor in certain mills.

Comprehensive and comparative tests are urgently required before any definite ruling can be laid down. Different problems have to be faced in milling from any that occur in other engineering professions. Tensile, impact, compression, hardness, ballistic, and other tests, are all known, and the figures obtained thereby all convey a definite meaning to the observer; but, on the other hand, when crushing or grinding ores, new factors are introduced. It is quite conceivable that the hardest steels, though theoretically the best for liners and balls, would assume almost a glazed surface during rotation, and the 'grip' on the ore would be lost, resulting in a gliding or rolling action rather than a grinding one.

ROCK-BREAKER JAWS

Cast-iron, plain carbon, chrome, and manganese steels are all used for this purpose. When chilled, the first-

mentioned is claimed to be the most economical when crushing soft ores, but the consensus of opinion is greatly in favor of manganese steel. Del Mar¹⁶ suggests a 13% manganese content as desirable. Johnson¹⁷ gives interesting figures relative to the wear of chrome and manganese steel plates when crushing the same class of ore, but omits any reference to chemical composition.

	Chrome steel	Manganese steel
Weight of set, pounds	921	740
Cost f.o.b. mill	\$96.93	\$72.62
Tons milled	72,206.2	86,478.7
Cost per ton milled, cents	1.38	0.84

On another test a set of chrome-steel jaws crushed 48,736 tons, against 99,451 tons by manganese-steel jaws. Gyratory crushers of large size are now built, the Traylor company within the last few years having erected one with a capacity of 2500 tons per hour. The wear on the mantle of this type of crusher is put down at the low figure of 0.0032 lb. per ton of ore. The extreme toughness of manganese steel especially fits it for all classes of crusher jaws, and it would appear useless to look further for a specification when ordering this variety of milling machinery. The use of manganese steel might be advantageously extended to trommels, battery-screens (punched or slotted), and grizzlies.

TUBE-MILL LINERS

Cast-iron is said to crack, and steel (without reference to type) is to be preferred for tube-mill liners. Jones¹⁸ gives the results of tests at the Tonopah Belmont mill as follows:

	Cost	Life
Manganese-steel lining	6.4c. per ton	16½ months
Hard, white iron	1.73c. per ton	2 years (estimated)

With the addition of new ribs, the crushing cost of the manganese lining was reduced to 4.57c. per ton, and 10 months was added to the life.

Any suggestion that will tend to reduce costs by increased efficiency and saving of time and labor merits the serious consideration of mine-owners and company directors; and I would again emphasize the necessity for the collection of reliable data and the whole-hearted assistance of steel-makers, mine and mill managers. This is essential if any real and rapid advancement is to be made. Prejudice is a very hardy plant and dies slowly. In conclusion I would quote C. T. Hutchinson's remarks published in the 'Mining and Scientific Press', of October 28, 1911:

"The only possible way to eliminate poor-quality material that is turned out by manufacturers today would be the consummation of an agreement between all manufacturers, themselves working toward a standardization of mill specifications for the benefit of the users, and their own protection against many unjust claims for replacement."

¹⁶M. & E. W., Apr., 1914.

¹⁷E. & M. J., 1916, No. 101, p. 907.

¹⁸Bull. A. I. M. E., Aug., 1915.

¹⁵Jones, Bull. A. I. M. E., Aug., 1915.

REVIEW OF MINING

SCIENTISTS DECLARE SMELTER-SMOKE DAMAGE NEGLECTIBLE

Final reports in the litigation wherein a number of farmers in Salt Lake valley sought to recover from the American Smelting & Refining Co. and the United States Smelting Co., for alleged damage to farms by smelter smoke, were filed in the United States District Court on March 3. Suit against the smelting companies was started in 1914, but it was not until 1916 that the cases were heard. In the latter part of 1919, Judge T. D. Johnson rendered a decision, ordering that Dr. Robert E. Swain, who held the chair of chemistry at Stanford University, be appointed the Commissioner of the court to watch operations at the smelters during 1920 and make a report to include his field observations and his recommendations as to future operations. Among the assistants appointed by Dr. Swain were Prof. Wm. E. Barber, Crawford M. Kellogg, Lloyd Macey, and Lawrence A. Adams of Stanford University. The expense of this investigation is to be borne by the smelting companies. The final report embraces 483 pages, and the gist of the findings is that no damage is now being done by the smelters, owing to the bag-house system and the Cottrell process now in use.

CANADIAN INSTITUTE MEETING AT MONTREAL

The 22nd annual meeting of the Canadian Institute of Mining & Metallurgy was held at Montreal on March 2, 3, and 4. In addition to technical sessions there were conferences on special subjects, visits to industrial plants, and meetings of a social nature. Moving-picture films showing the processes used in the mining and refining of nickel and in the recovery and refining of petroleum were exhibited. A smoker and concert was held on the evening of March 3 and on the evening of the 4th the annual banquet took place at the Montreal Club. O. E. S. Whiteside, manager for the International Coal & Coke Co., the incoming president, delivered the principal address.

CALUMET & HECLA PRESIDENT FORESEES ESTABLISHMENT OF COPPER-MANUFACTURING INDUSTRY NEAR THE MINES

That the Calumet & Hecla Mining Co. eventually will be forced to make its own copper manufactures was predicted by James MacNaughton, general manager, in an address to Calumet business men. There is no immediate prospect of entering upon this venture, but according to Mr. MacNaughton there is no question that the time will arrive when it will be the logical proceeding. In this connection it was brought out that the use in manufacturing by Calumet & Hecla of its own copper would not be profitable unless it were to handle its entire output, thereby avoiding possible discrimination against C. & H. metal. It is Mr. MacNaughton's opinion that the manufacturing project would enable the operation of the mines on a more profitable basis.

Mr. MacNaughton emphasized the fact that the manufacturers of copper products are making more profit than those who mine the metal. "They take no risk", he asserted, "and can conduct their business as long as they see fit, purchasing metal from the market. Their business is assured as long

as they can buy copper, but a mine is continuously expending its capital, which is its metal underground, and eventually the supply is exhausted." Continuing, Mr. MacNaughton said: "Copper before the War was a luxury and during flush times people used the metal in a luxurious sense. During the War, however, there was a noticeable shortage, and, as a result, steel, zinc, and other metals supplanted copper. Whether copper will return to its former status depends on whether the public can be re-educated to its use. Even now it is impossible to purchase copper tacks, which a few years back were procurable at any hardware store. The same holds true of many other products formerly made of copper."

UTAH COPPER CUTS QUARTERLY DIVIDEND; RAY CONSOLIDATED PASSES DIVIDEND

Directors of the Utah Copper Co., at the meeting in New York on March 3, cut the regular quarterly dividend rate from \$1.50 to \$1. This conservative action in regard to dividends was expected by those familiar with the company's finances.

Only the very strong cash position of the company has enabled it to maintain its dividend of \$6 per share on the 1,624,490 shares outstanding. The company produced 104,616,988 lb. of copper last year, just 50% of capacity. Its cost averaged 13½c. per pound, against an average sales price for its copper of 17.60c. (the company combining its actual sales figure with its unsold copper, inventorying the latter at 13½c. per pound). Net earnings were equivalent to \$3.09 per share, which, after the \$6 dividend, left a deficit of \$4,722,441, against a deficit in the year previous of \$1,494,544. In short, Utah in two years has dipped into surplus to the amount of over \$6,200,000 to pay dividends.

Ray Consolidated passed its regular quarterly dividend, which had been cut to 25c. per share three months ago. The company during 1920 earned 41c. per share on its 1,577,000 shares and paid dividends of \$1 per share, showing a deficit of \$665,503. The company produced 48,153,361 lb. of copper at a cost of 15½c. per pound.

The Kennecott Copper Corporation passed its regular 50c. dividend some time ago in anticipation of the cutting of Utah Copper rate. The Kennecott company owns 616,504 shares of Utah Copper stock. Kennecott has not curtailed production to the extent that most of the producers have. Its output last year of 108,367,280 lb. of copper was nearly 27,000,000 lb. more than in 1919, both years including the entire output of Braden. But because of its Bonanza orebody in Alaska and steadily diminishing costs in South America, the company has been able to make a profit on whatever metal it could sell even at the receding prices which have obtained since last January.

BRITISH COLUMBIA IS WILLING TO SUBSIDIZE STEEL BUSINESS

The government of British Columbia has entered into an agreement with the Coast Range Steel, Ltd., a new Provincial incorporation, under the terms of which the Government undertakes to pay bounties on pig-iron manufactured in the Province from local ore to an amount not exceeding \$3 per

long ton and on pig iron manufactured in the Province from foreign ore to an amount not exceeding \$1.50 per long ton. It is set out that British capitalists are ready to invest the necessary money, "not exceeding ten million pounds", in the establishment of the industry upon the execution of the agreement and upon receipt of the report of engineers now engaged in the Province investigating the iron-ore resources, that conditions are suitable. These particulars were laid before the Provincial Legislature recently. It is further stated that the incorporation fee had been reduced to \$50 in order to encourage the enterprise.

STANDARD OIL OF NEW JERSEY INCREASED PRODUCTION 56% DURING 1920

Production of crude oil by the Standard Oil Co. of New Jersey in 1920 was 31,200,000 bbl., against 20,000,000 in 1919, an increase of 56%. This production includes that obtained from various fields of the world in which subsidiaries of the company operate, and oil from its natural gas properties. These subsidiaries include International Petroleum company, Ltd., operating in South America, Transcontinental company, of Mexico, Romano-Americana of Rumania, and domestic subsidiaries.

The average daily production in 1920 was about 85,246 bbl., against 54,794 in 1919. Largest contributors to the increase were Standard Oil of Louisiana and Transcontinental companies. The total crude-oil run through six refineries in 1920 was 17% larger than in 1919, the gain being accounted for by increasing capacity of five refineries by 57,000 bbl. The new plant at Charleston, S. C., and that of Humble Oil & Refining Co. were not included because they were not completed in 1920.

Three companies have been formed: a distributing organization which is now operating, and whose objective is the introduction of bulk delivery of refined oil and gasoline to the French public; a company for the sale of fuel-oil; and a producing company for operation in France, French colonies and mandates. Standard Oil also has organized a new company in Finland and hereafter will market directly in that country. It has acquired a substantial interest in one of the old operating companies in Poland and it is also investigating possibilities of establishing a market organization in the Slav States.

At the close of 1920 the company's fleet of tank-ships consisted of 47 steamers, with a total deadweight capacity of 479,502 tons, all of which fly the American flag. In addition, its various subsidiaries have substantial tanker tonnage under foreign registry. Nine additional tankers, aggregating 141,480 tons deadweight capacity, are being constructed. The company's business is about evenly divided, 49.5% being domestic, and 50.5% exports.

SOUTH AMERICAN GOLD & PLATINUM CO. IS PRODUCING SUCCESSFULLY

After nearly ten years of development work the placer properties of the South American Gold & Platinum Co. on the San Juan river in Colombia, are finally operating on a commercial basis, according to official statements given out by the management of the company. The 400,000-ton dredge which was used in experimental work is now producing from the best ground mined to date. The second dredge, with a capacity of a million tons per year, has now dug its way into the mineralized gravel and is also saving a good product. A third dredge is under construction and will be at work before the end of the year.

EXPORT TRADE IN ZINC

Statistics recently issued show that our export trade in zinc pigs, slabs, etc., dropped to the lowest point reached for

many years during the last two months of 1920. The sharp decrease was especially pronounced after the large volume of the metal that moved overseas during the early months of the year.

Our December exports of zinc slabs, etc., amounted to but 52,862 lb. compared with 161,508 lb. in November, and an average export trade of better than 20,000,000 lb. per month during the first ten months of 1920. France and the United Kingdom, which were formerly our best customers, are now practically out of the market, the United Kingdom taking but \$893 lb. in December, while not a pound was shipped to France that month. To the latter country our total exports last year amounted to 49,432,285 lb., and to the United Kingdom 135,026,068 lb. In November the United Kingdom was out of the market entirely, while but 842 lb. was shipped to France.

Our export trade in zinc rolled in sheets, strips, etc., has held better than that in pigs and slabs. December exports of the former amounted to 784,388 lb., against 1,079,270 lb. in November. For the year this export trade amounted to 23,665,270 lb., valued at \$2,827,590, compared with 39,524,516 lb., valued at \$5,212,002 in 1919.

The following shows the extent of the drop in our export trade in zinc pigs, slabs, etc., during the closing months of last year:

Month of 1920	Pounds	Value
January	27,933,222	\$2,303,859
February	35,073,120	2,509,268
March	28,058,238	2,307,069
April	29,900,771	2,514,634
May	17,003,151	1,489,295
June	26,453,674	2,151,343
July	17,060,129	1,452,196
August	16,464,364	1,412,890
September	3,195,855	289,918
October	2,253,067	218,220
November	161,508	16,447
December	52,862	6,707

The following shows the destination of our export trade in zinc pigs, slabs, etc., during each of the past three years:

Exported to—	1920	1919	1918
France	49,432,285	61,631,164	68,870,314
Italy	1,242,754	17,864,491	14,835,526
Norway	29,521	598,475	571,261
United Kingdom	135,026,068	112,617,044	65,538,551
Canada	391,375	4,633,392	12,765,324
Mexico	471,226	229,102	970,882
Japan	4,738,527	36,301,738	7,567,719
Australia	2,088	515,402	224,000
Other countries	13,059,467	9,439,440	1,438,823

ARIZONA

Bisbee.—At the Wolverine mine a night shift has been put to work in order to expedite development work on the 300-ft. level from No. 1 shaft. James Mally is in charge of the work. He says that no attempt will be made to ship ore under present conditions of the copper market.

Kingman.—A new district is being opened in the heart of the Arizona desert. The leading property is the Catherine mine, in which it is said ore worth more than \$1,000,000 is in sight. One drift 1800 ft. long is said to be entirely in ore averaging \$15 per ton while the vein averages 20 ft. in width. A few miles north-easterly is the Sheep Trail mine, an old producer that is being re-opened. The district is 40 miles from here on a good auto road.

Miami.—The capitalization of the Louis d'Or mine has been increased \$4,000,000. The company owns a wide belt of good ground two miles long. Indications of copper are found throughout the zone. A 700-ft. working-shaft is to

be started.—The Iron Cap property has discharged all employees with the exception of watchmen, while about 25 men are at work at the Superior & Boston.—The great chimney of the International smelter at Miami has been completed and change to it will be made soon from the old steel stack, which is showing signs of deterioration through the effect of sulphuric gases. The new stack is 275 ft. high, 34 ft. in diameter at the base, and 22 ft. inner diameter at the top. It contains 2000 tons of brick and is designed for resistance to a wind pressure considerably greater than 100 miles per hour.

A comfortable addition to surplus was made by the Miami Copper Co. during 1920. Its dividend requirements of about \$1,500,000 were more than covered by earnings. This was due in large part to the management's policy of meeting the market for copper. As a result, Miami brought comparatively little unsold copper forward into 1921 and today has no difficulty in carrying whatever metal it has not yet marketed. The company has no participation in the export pool of 400,000,000 lb. and has no need for borrowing money at this time. It was one of the original members of the Copper Export Association but soon withdrew, as it desired to dispose of its own copper abroad as well as in the domestic market. But little development work has been done of late by the company and its new construction today consists almost entirely of finishing a new shaft, started about two years ago. Since January 1 wages have been lowered to the extent of more than \$300,000 per year.

Pearce.—The Commonwealth mine, under the management of A. Y. Smith, is now shipping 30 cars of tailing and 15 cars of ore per week to the Calumet & Arizona smelter at Douglas. The tailing is from a cyanide plant operated by Smith & Swatling some years ago.

Quartzsite.—At a depth of 600 ft. in the Copper Cliff mine, 12 miles north-west of here, a 5-ft. vein of sulphide ore that assays 12½% copper and contains some gold and silver has been found.

Tombstone.—A carload of machinery for the new 100-ton mill of the Tombstone Co-operative Milling Co. was unloaded at the site of the plant during the first week of March. The second shipment is due. It is expected to have the mill in operation before May 1.

CALIFORNIA

Downieville.—Gravel running \$2 per yard is reported to have been found in the Mount Alda mine. A drift was started 1800 ft. from the mouth of the adit, the channel being cut at a distance of 200 ft. More than 4000 ft. of virgin ground is available if the theory of the formation of the channel is correct. C. N. Chatfield, Hawley Chatfield, and Harvey Mohler own the property.

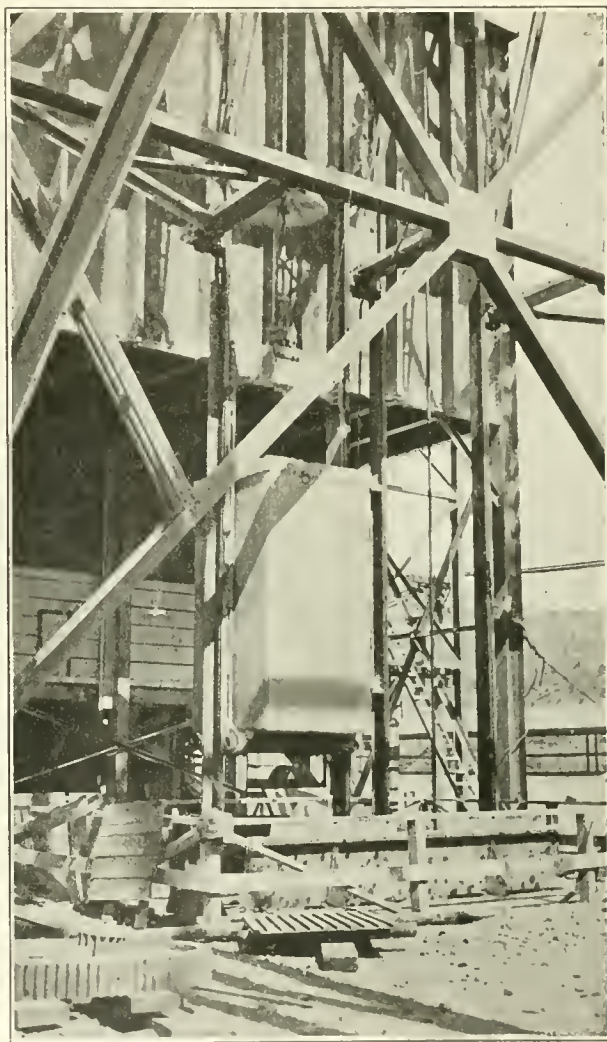
Grass Valley.—The Grass Valley Boundary mine is to be unwatered in preparation for development. M. J. Brock is in charge of the property.

Portola.—Approximately 700 men are employed in the mine and mill of the Engels Copper company. The flotation plant is treating 800 tons per day from the Engels and Superior mines.—At the Walker mine, owned by the Anaconda Copper Co., only development work is being done, although it is rumored that production may be resumed.

Redding.—Testimony was taken during the first week in March in the contest between the Federal government and the Central Pacific Co. over the title to lands near the Niagara mine west of French Gulch and in the neighborhood of the Deadwood and Brown Bear mines. The Government contends that the land is more valuable for the exploitation of its minerals than for other purposes. The issue will be decided finally by the Department of the Interior at Washington.—W. W. Robinson has started development work on the Climax mine near Igo. He has erected a plant of

capacity to sink a shaft 500 ft. The Climax was once a well-known producer of silver as well as gold, but has not been productive since 1896.

Sutter Creek.—Diamond-drilling will be commenced at the Old Eureka mine, other work being suspended in the meantime. The present company purchased the property from Mrs. Hetty Green five years ago, since which time many thousands of dollars have been expended in unwatering and equipping the mine. A 1000-ft. shaft and drifts and cross-cuts have been driven without encouraging results. Dia-



12½-Ton Skip, No. 1 Shaft, Ray Con. Mine, at Ray, Arizona

mond-drilling is to be undertaken to determine the advisability of further sinking.

COLORADO

Aspen.—Excitement is running high owing to the discovery of high-grade silver ore in the breast of the Hope tunnel, where a six-inch streak running diagonally across the face, is said to be practically pure native silver. The strike has been pronounced the richest made since the discovery of wire silver in the Little Annie a quarter of a century ago. The more important feature of the discovery is the great depth at which the ore is found, about 2500 ft. below the surface. The tunnel, started nine years ago, has been driven 1½ miles to explore Richmond hill. A great many business men in Aspen, and 'traveling men' from every part of the country, are numbered among the stockholders in the Hope Tunnel Co. The stock, that last week could have been purchased for \$1 per share, cannot now be had for \$3.

The vein in which the rich streak is found has been proved by drift for some 85 to 95 ft and has been cross-cut more than 40 ft with no wall in sight. The Hope company controls practically all holdings on Richmond hill, including the Little Annie mine.

Ten men are at work in the Cowenhaven tunnel, planned to exploit the Woody Creek region at great depth. The tunnel has already been driven approximately 3½ miles and will be extended.

Cripple Creek.—The Ajax property, formerly owned by the Ajax Gold Mining Co., now controlled by E. A. Colburn, of Denver, is shortly to resume operations. Men are overhauling machinery and doing other preparatory work. Thomas Harr has been engaged as superintendent. — George Bernard, president of the Elkton Consolidated Mining & Milling Co., has organized the Elkton Leasing Co., secured a five-years lease on the Haven Hill property, and commenced operations. The plant was put in operating condition by the owning company. The lessees will develop territory north of the shaft, below the 600-ft. level. The main Elkton shaft connects with the Roosevelt drainage tunnel at 1675 ft. — The Cresson mine continues heavy production, shipping from 6 to 9 cars of ore daily to the mill of the Golden Cycle M. & R. Co. at Colorado Springs. Most of the ore is from recently developed orebodies.

Leadville.—The Chamber of Commerce and Mining is seeking to establish a fair royalty rate to apply to leased properties now inactive, and a readjustment of royalties at properties already leased on a fairer basis. Mining companies and individual owners with a few exceptions are reported to favor the plan.

Telluride.—The Smuggler mill has 65 stamps in operation and one of the ball-mills treating ore. A good grade of concentrate is being made. — The Ruutilla-Brown Leasing Co. has shipped six cars of ore from its Carbonero lease and ore for another will be packed out on mule-back. — The Shoofly tunnel on the Carbonero is being extended by the McAlpine Leasing Co., to cut one of the cross-veins now about 60 ft. distant. — The Favorite mine at Ophir is under lease to F. Saunders and Telluride associates who will at once ship a car of smelting-grade ore to Durango.

IDAHO

Coeur d'Alene.—The long cross-cut tunnel at the Hypotheek property at Kingston has entered the vein, toward which miners have been working for the last year. The adit has been extended for 20 ft. with no hanging wall in sight, the vein containing stringers of lead-silver ore. — Operations at the West Sunset property, which adjoins the Tamarack in the Nine Mile district, have revealed a high-grade silver-lead ore-shoot four feet wide.

The Independent Lead Mining Co. has levied an assessment of one cent per share and has resumed development work on a group of claims adjoining the Morning mine. The work is confined to opening the lower tunnel, which had caved near the portal. Later more work will be done in two upper tunnels, both of which have opened a vein of lead-silver ore of milling grade. — At the Midnight property a raise is being driven from the Fanny Gremm tunnel-level 1100 ft. to the surface. The heading is now up 500 ft. Some prospecting has been done with drifts from the raise, showing a body of milling ore containing lead and zinc, with zinc predominating.

The lower cross-cut tunnel in the Enterprise property, which is now more than 1000 ft. long, has passed through a hard diorite formation and is again in the quartzite with a heavy flow of water coming from the face of the tunnel. — Contracts have been let for an additional 75 ft. of drift in the Eldorado tunnel near Kellogg. The ore now exposed contains silver, lead, and gold and it is thought that the main orebody is being entered by the drift.

The Copper King Mining Co. has levied an assessment of one-half cent per share, payable March 26, for financing diamond-drill development. The vein will be prospected as deep as the National tunnel level, which is 400 ft. below the lower tunnel of the Copper King. The work will prospect 1000 ft. along the vein. One drill-hole has been completed, tapping the vein at 80 ft., where the drill-core shows five feet of solid ore on the hanging wall and one foot on the foot-wall, with 15 ft. of milling ore lying between the two streaks.

Moscow. A bulletin recently issued by the Idaho School of Mines discusses a number of mining districts in the southern part of the State that are handicapped by lack of accessibility. These are the Thunder Mountain, Big Creek, Stanley Basin, Sheep Mountain, and Seafoam districts, where large bodies of low-grade ore are said to be awaiting development.

Pocatello.—At the Rockford mine, in the Gem district, Charles Garonson has followed a well defined vein for a distance of 300 ft. in a 1000-ft. drift. The vein contains some galena.

MICHIGAN

Calumet.—While the low market for copper continues, mining costs continue high. This is particularly true of the price of materials. Some reductions have been made, but costs are still far above those of former years. Some companies have managed to save money on labor account, but the abnormal cost of power, steel, and other materials continue to contribute to high production costs. No relief from this condition is expected for fully a year. Some reduction in coal prices is expected when orders are placed the coming summer for the following year's supply, but the relief from this direction will be small.

According to reports, Calumet & Hecla has cut the Kearsarge lode in a cross-cut east from the 81st level of the Red Jacket shaft. This vein near the surface is a half-mile distant from the Calumet conglomerate. Its dip is 36°, but it is possible that at great depth it flattens somewhat. This and the fact that the Red Jacket shaft is vertical and is sunk clear through the Calumet conglomerate would bring the bottom of the shaft and the Kearsarge lode closer together. Calumet & Hecla has three shafts opened on the Kearsarge, but has done no work in two of them since 1907 and in one since 1913.

Arcadian Consolidated in its New Baltic shaft has reached its objective, 942 ft., and the work of cutting a station, preparatory to drifting toward the New Arcadian shaft, is under way. Connection will be made with the 900-ft. level of the New Arcadian. The New Baltic has been in and out of the lode, and at present depth there is no change in the character of the ground. To connect the two shafts it will be necessary to drift 2500 feet.

Wolverine has prospects of commercial ground in the Kearsarge conglomerate, west of the amygdaloid, and in an amygdaloid vein opened by a cross-cut from the 28th level. The conglomerate was tapped by diamond-drills and some drifting was done on the new amygdaloid. The showing in both appears to warrant exploration, but this work will not be undertaken while costs are high. The Kearsarge conglomerate was found profitable in the old Ahmeek, but has not been mined elsewhere.

The only important construction work so far planned in the district for the coming summer is the reclamation plant at the old Tamarack sands. The foundations for the flotation and leaching buildings were laid last fall, and steel is now being fabricated for the superstructures. It also will be necessary to construct a dredge to handle the sands. The building for the re-grinding unit has been completed but not equipped. The plant will not be ready for use until the summer of 1922.

MONTANA

Butte.—During the final quarter of last year the Butte & Superior company recorded a net loss of \$169,000. Production was discontinued entirely on November 10, since which time a small organization and limited force of men have been retained to maintain the plants and carry on development work. Only 30,000 tons of ore was milled during the quarter. The zinc content showed some improvement, averaging 14.37%. The silver content was 5.59 ounces.

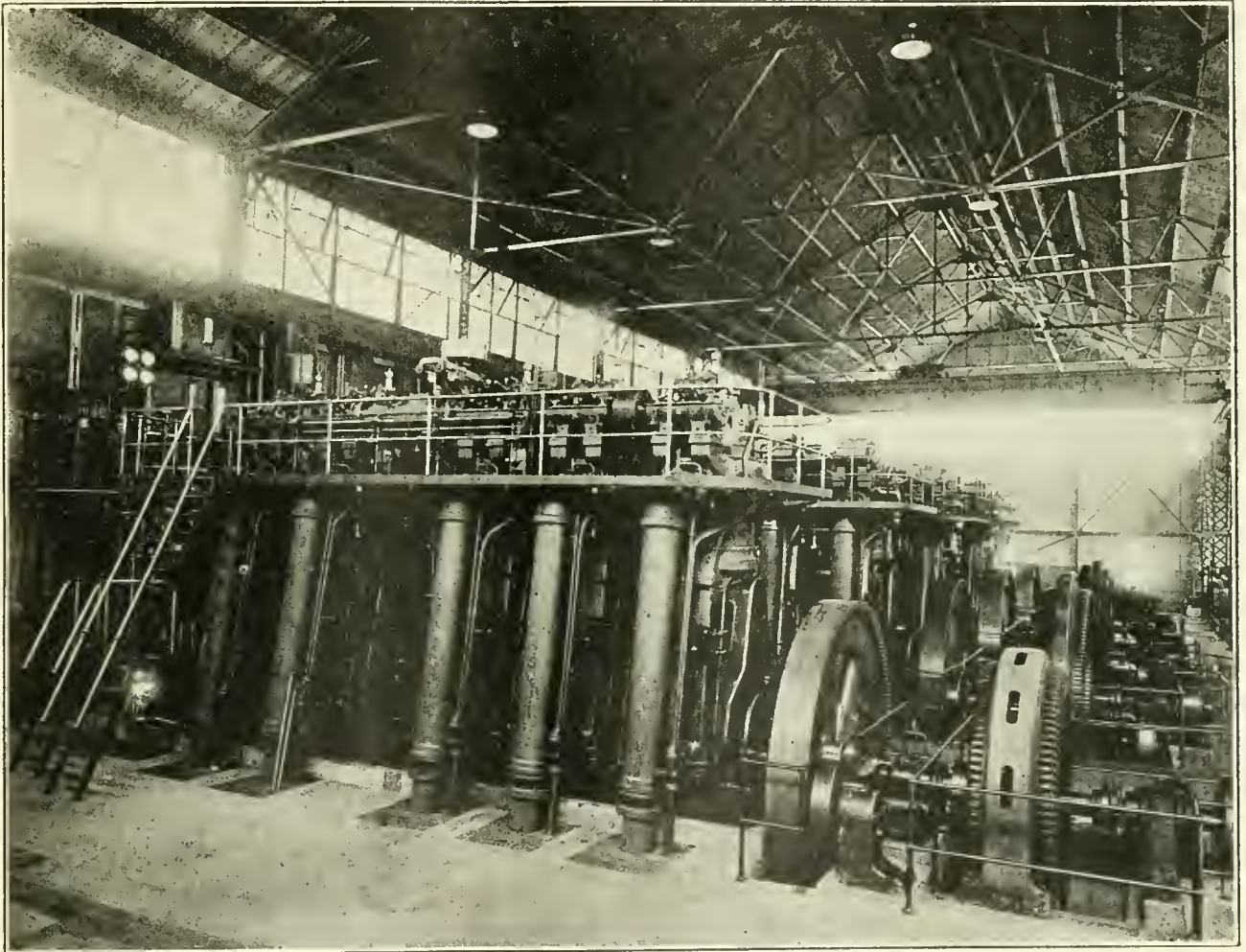
Lessees have cut into ore in the North vein at the Hibernia mine of the Davis-Daly company. The vein was cut on the 600-ft. level, where 2½ ft. is reputed to have a silver

for the treatment of old tailing. The results of the diamond-drill work being done have proved better than expected.

Dillon.—L. B. Lyons has taken six miners to the Silver Spray mine 21 miles south-east of here. A 3-ft. vein of copper ore, from which some production has already been made, will be developed by driving a new adit.

Lump Gulch.—The sinking of No. 3 shaft of the Pay Back Mining Co. is to be undertaken soon. The mine was worked some years ago, producing some of the richest ore ever hauled to a smelter. Veins can be traced for 3000 ft. over the company's property.

During the week a carload of rich silver ore from the Free



Diesel Engines in Power-Plant at Tyrone, New Mexico

content of 55 oz. This is the first ore to be found in this fissure, all the ore heretofore occurring in the South vein. Shipments from Hibernia are averaging 23 oz. silver per ton at the present time. Davis-Daly received around \$24,000 net from the operations of January. The orebody in the South fissure on the 600-ft. level of the Anaconda property adjoining is 70 ft. deeper and shows the continuation of the 600-ft. level deposit. Arrangements are under way for sinking the Hibernia shaft from the 600 to the 800-ft. point, with a re-modeling of the hoisting-engine to care for the added load. One of the secondary air-compressors at the Colorado mine, with a capacity considerably in excess of the present air-compressor at the Hibernia mine, will be removed to the latter property.

Corbin.—Construction work on the new mill of the Alta Consolidated Co. has been started. The mill, which will have a capacity of 1000 tons per day, will be used at the start

Coinage mine of the Amalgamated Silver Mines Co. has been shipped to the smelter at East Helena.—At the Little Nell mine, operated by the Bunker Hill & Sullivan interests of Idaho, sinking has been discontinued and drifting on a number of veins cut by the shaft will be started.

NEVADA

Carson City.—Judge Farrington, of the U. S. District Court, has dismissed the suit filed in 1918 by the G. S. Johnson Co., brokers, of San Francisco, in which the latter sought to recover for alleged profits claimed to be due them on a stock transaction. The Nevada Packard Mines Co. was the defendant.

Divide.—The new board of directors of the Tonopah Divide, elected at the annual meeting in Tonopah, is composed of H. C. Brougher, W. J. Douglas, Clyde A. Heller, E. W. Blair, and E. J. Erickson. George Wingfield was not

re-elected and it is understood that whatever remaining interest he may have is looked after by Blair, who is a Wingfield man. No report of mine conditions was issued, but it is said that a report by George H. Garrey will be issued in April. It is rumored in Tonopah and Goldfield that recent developments on the 800 and 1000-ft. levels have given Garrey the basis for a favorable report, in which the Julian and Farrell reports may be controverted.—The Brougner has resumed sinking of a winze to 1000 ft., where, after connection has been made with the Tonopah Divide, prospecting will be done for the extension of ore found on the 718-ft. level.

Goldconda.—Thomas Major and Fred Backus are working the Gold Coin mine where they have opened several good bodies of free-milling gold ore. They have purchased the Gibson mill, which is now being hauled to the property. They expect to have it in operation by the first of April.

Goldfield.—Additional work has failed to find the limits of the orebody opened recently in the Cracker Jack lease on the Florence. A winze, raise, and two other faces are being continued in ore. The last assay taken in the raise gave a return of \$100 for the entire top.

Eureka.—Cross-cuts from the main drift of the Eureka Holly mine on the 600-ft. level have been started to tap the orebodies. Ore is being blocked out on the 400 and 500-ft. levels. Some changes are being made in the power to be used in the new mill. Additional parts needed are expected to arrive any day.

Klondyke.—An 18-in. width of 100-oz. silver ore containing silver glance has been opened by the Ben Hur in cleaning a 50-ft. shaft.—Five sub-leased blocks are being mined in the Original Klondyke.

Manhattan.—The Manhattan Consolidated elected new directors at a meeting called following dissatisfaction with the affairs of the company, according to A. J. Twilegar and J. A. Gibbons, newly elected officials. These two officials said, although, according to a report made at the meeting by Mark Page, superintendent, there was \$1,000,000 worth of ore blocked out on the third level, with similar conditions on the fourth and fifth levels, that the mine had been idle since March 1, 1920, and that the expenses from then until the date of the meeting had been more than \$8000. According to the report of the superintendent, the ore on the third level assays \$19 to \$55. With funds derived from 13 assessments a 555-ft. shaft has been sunk and much lateral work has been done. The mine is well equipped and all of the workings are in good condition. The ore to the 300-ft. level is free-milling, but below that it contains arsenic and other constituents that make it refractory.—The workings having been drained of water, work is soon to be resumed on the 800-ft. level of the White Caps.

Peavine.—The drift in the orebody found recently in a cross-vein south of the shaft and on the 300-ft. level of the Standard Metals is being continued and cross-cuts show the width of the ore to average 7 to 10 ft. The average value for this width is \$25 to \$30, with 3 to 5 ft., giving returns of \$75 to \$100. Besides silver, the ore also contains gold, copper, and lead. Ore has been practically continuous on this level for 200 ft. The ore beyond a break in the vein, apparently having no connection with the ore on the upper levels, has been opened for 75 ft. and there is no indication that the end of the shoot is near.—The shaft of the Black Panther, being sunk to 500 ft., is now 275 ft. deep. It is being continued with two shifts of miners.

Rawhide.—The Nevada-California Milling Co., a new organization, is to build a 25-ton cyanide mill at Rawhide, in which it is planned to also treat ore from the Rand district and Eagleville. The site selected is less than 10 miles from each of the three places. Operators from Taft, California, are the promoters of the company.

Rochester.—An important find has been made on the Mac-Namara lease on the property of the Argentor-Rochester Mines Co. in a cross-cut from the main adit. The ore is siliceous and is heavily impregnated with cerussite and limonite. The vein is said to be 12 ft. in width, while daily samples taken from No. 3 raise show an average assay of \$76.80 per ton, nearly all gold. The property is owned by the Argentor company, of which C. N. Miller is president and general manager.

Round Mountain.—The Round Mountain has started placer mining a month before the usual time, one giant being used on two shifts.

NEW MEXICO

Hillsboro.—It is rumored that S. H. Bernard and associates, who own the Miner's Dream and Savage groups at Kingston, will erect a custom smelter in the vicinity of Lake Valley or Nutt Station, to treat ores from the various mines in Sierra county.

OKLAHOMA

Picher.—Several miles of gravel roads have been built by unemployed miners as the result of the efforts of the Tri-State branch of the American Institute. Contributions to the wage-fund are made by mine operators in the district, together with the men employed at the operating properties. Much is being done to relieve the hardship among the families of the miners.

SOUTH DAKOTA

Lead.—Excavation work for the new Homestake South mill, which will be built east of the Ellison hoist, and on the south side of the slope immediately above cyanide plant No. 1, is progressing and the large force of men employed in working on the structure should complete the mill early in the fall of this year. The general dimensions of the South mill main building are 120 by 160 ft., the classification-annex is 70 by 70, and the slime-settling annex is 100 by 40. The general metallurgical scheme is stage reduction, amalgamation after each reduction, and the separation of sand from slime with cyanide treatment of each product in existing plants. The capacity of the mill will be 1800 tons daily; it is so arranged that additional units can be added from time to time as the amount of production increases.

The Trojan Mining Co., the second largest producer in the Black Hills district, has purchased all the mining property of the Ofer Mining Co. in the Bald Mountain district. The new territory is expected to add materially to the life of the mine.

UTAH

Eureka.—A connection between the older workings of the mine and the No. 2 shaft has been made on the 1800-ft. level at the Chief Consolidated mine. This will be of decided advantage in handling ore and waste material, as the No. 1 shaft has been taxed to capacity.—The Tintic Standard Mining Co. is constructing a new combination office and warehouse building. The company recently completed a new assay-office.—Hugh Trenholm, field engineer for the various Knight mining interests, spent several days here recently. He states that while little development work is being done now at the properties controlled by the Knights, he looks for an improvement by summer. A raise from the Tintic Drain tunnel is now up 300 ft., and will reach the surface in another 300 ft. It is probable that when this raise is completed, work of driving the tunnel will be resumed, if metal prices should improve.

At a meeting of the stockholders of the Tintic Mayflower Mining Co., H. G. Snyder was elected president; E. L. Howell, vice-president; J. C. Anderson, secretary and treasurer; J. Wm. Knight and W. L. Brimhall, directors. An assessment of one-fourth cent per share was levied, the pro-

ceeds to be used to develop further the company's property adjacent to the Tintic Standard mine.

Production of ore made during the week ending March 4 totaled 169 carloads, as compared with 178 carloads for the week preceding. Mines and the number of carloads of ore produced by each follow: Tintic Standard, 53; Chief Consolidated, 37; Dragon, 20; Iron King, 17; Eagle & Blue Bell, 12; Victoria, 8; Grand Central, 5; Iron Blossom, 5; Alaska, 3; Gemini, 2; Mammoth, 2; Swansea, 2; Bullion Beck, 2; Centennial Eureka, 1. Total, 169 carloads.

Milford.—At the Capitol Hill mine, four miles from here, good silver-lead ore has been uncovered by an inclined shaft sunk on an east-west fissure. The vein is from 4 to 8 ft. wide, and a rich streak of ore, on the hanging-wall side, has been continuous to the bottom of the shaft, now at a depth of 182 ft. A composite average of this ore gives returns of \$2.20 in gold, 10 oz. silver, and 28% lead. At a point 75 ft. easterly from the bottom of the shaft, ore has been found averaging \$75 per ton in silver and lead.

Moab.—The Panama Mining & Milling Co. has been organized by residents of Colorado to develop a silver-copper property in the easterly slope of the La Sal mountains, near here. Fred McCoy will be manager. Shipments of ore prove that the silver content alone is more than sufficient to pay all expenses of mining, transportation, and smelting.—Preston G. Peterson, secretary for the Big Indian Copper Co., about 40 miles south of here, states that operations will be resumed at once. On account of severe weather water-pipes supplying the milling plant froze, necessitating the suspension of operations.—H. K. Thurber, manager for the Tungsten Products Co., operating carnotite mines in Dry Valley, was in this district recently. He states that his company expects to purchase a fleet of trucks for transporting the ore to the railway, so as to permit of a larger output.

Ophir.—During 1920, the net proceeds of the Ophir Hill Consolidated Mining Co. totaled \$138,909. The value of the company's improvements are estimated at \$129,180, making a total valuation, for assessment purposes, of \$545,909, as the net proceeds are multiplied by three, for taxation purposes.

Park City.—During the week ending March 4, the district produced a total of 1921 tons of ore, as compared with a total of 1818 tons for the week preceding. Mines and the production follow: Judge allied companies, 965 tons; Ontario, 408; and Silver King Coalition, 448. Total, 1921 tons.

Salt Lake City.—A temporary restraining order to prevent the Rico-Wellington Mining Co. from selling stock of minority stockholders to cover an assessment of 10c. per share was granted on February 26 by Judge Tillman D. Johnson, on the condition that the plaintiffs furnish a \$1000 bond. This property is situated at Rico, Colorado, and is controlled by Jesse Knight and associates. About six weeks ago, an assessment was levied, and a number of the minority stockholders, headed by D. L. Fitzgerald, brought suit to prevent the collection of the assessment, which they contend is excessive.

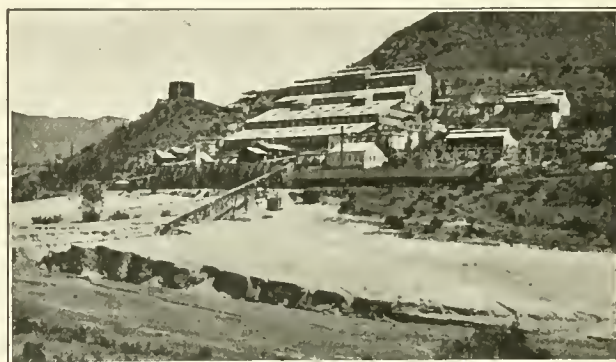
BRITISH COLUMBIA

Nelson.—Two new demands are being made upon the British Columbia Department of Mines by the B. C. Prospectors Protective Association through the Nelson branch of that organization. One is that prospectors should be extended financial assistance to the extent of \$1500 to \$2000 for the development of properties favorably reported upon by district mining engineers, and the other that stakes used in the locating of claims should bear a government metal disc. The Queen mine, the original producer of the Sheep Creek district, has been leased by C. H. Cassill, of Spokane. He also has taken over the Ore Hill group, at Mount Vernon. The former consists of 15 Crown-granted claims and the latter of five similar claims. On the Queen group is a 20-

stamp mill. The new operating company will be known as the Queen-Ore Hill Mines Co., which will be incorporated under the laws of British Columbia with a capital stock of \$250,000. The sum mentioned in the transaction is \$150,000, the final payment being due July 1, 1923.

Greenwood.—The Providence mine, near Greenwood, after several months idleness, is to resume operations. The plant is being put into condition and work is to be commenced on the 600 and 700-ft. levels.

Ferguson.—Recently a number of small silver-white nuggets were found in the placer sands a few miles up the Lard-deau river. They were sent to the laboratory of the Department of Mines, at Ottawa, and a report has been received stating that they are composed of 70% gold, 27% silver, and 1.8% mercury. It is not yet known whether there is any appreciable quantity of this material in the gravel, and mineralogists are in a quandary as to whether it is a natural mineral or whether the gold-silver particles have attracted mercury that has escaped from old placer-washing operations. A curious feature is that the particles are malleable, whereas one would expect the mercury con-



Mill of the Moctezuma Copper Co. at Nacozari, Mexico

tent would make them brittle. As far as it has been possible to ascertain, they appear to be homogeneous. It is likely that the discovery is one of scientific rather than commercial interest.

Windermere.—Preparations are being made for re-starting operations at the Bunyan mine, and a crew of 100 to 150 men will be put to work as soon as weather conditions allow. It had been the intention of the owners to operate the mine through the winter, but heavy snow came before the boarding-house was finished. Two shipments were made to the Trail smelter before the mine closed, and these are said to have given satisfactory returns.

MEXICO

Monterrey.—Mining operations in the different districts of the State of Zacatecas are reviving, notwithstanding the low price of metals. Many claims have been filed upon recently and properties which have been idle for some time are being placed in condition for production. Applications for title have been made by Edward P. Palmer, an American mining man of Zacatecas, to several groups of claims in the San Bernable section, near the Orlando and Soledad claims, which are producing high-grade silver and lead ores. He plans to increase the scale of operations.

ONTARIO

Sudbury.—The mine and smelter of the British America Nickel Corporation were closed down last week, throwing over 600 men out of employment. Low prices for metals was assigned as the reason. As soon as the matte now being shipped to the refinery at Deschenes has been refined, that plant will also be closed, increasing the number of the unemployed by about 400. A nucleus of the organization will

be retained so that when conditions improve, production can be resumed at short notice. The Mond Nickel Co. has cut wages 5c per hour.

Port Arthur. The Atkocan iron mine, one of the largest iron properties on the continent, has been purchased by Chester K. Quinn, of Duluth, from the National Trust Co., trustee for the bondholders, for \$1,500,000. The city of Port Arthur had invested \$200,000 in the mine and blast-furnace to assist in the establishment of the iron industry there. The mine is situated 130 miles west of the city.

Kirkland Lake. The Lake Shore during January produced \$37,376 from the treatment of 1674 tons of ore, being an average recovery of \$22.32 per ton. The mill ran 82% of possible running time. A station at the 600-ft. level has been completed and drifting and cross-cutting begun.—At the Kirkland Lake mine a vein has been discovered at the 700-ft. level with about 4 ft. of high-grade ore. The company has now sufficient electric power to operate both the mine and mill at full capacity.

The shaft of the Huntoon-Kirkland is now down 90 ft. At the depth of 65 ft. the ore, dipping into the shaft, had gold content of \$15 per ton.

Porcupine.—The McIntyre has secured the right to develop electric power at Sturgeon falls on the Mattagami river about 30 miles from the mine, and also the right to develop below Sandy falls, which would be wiped out by the development of Sturgeon falls. This gives the McIntyre an opportunity to generate 9000 hp. If it should be found necessary, but whether it will do so depends on what action the Northern Ontario Power Co. will take to keep up the supply and avoid future shortage.—Machinery purchased from the Dome Lake is being hauled to the North Davidson, where a large amount of exploration and development work has been planned.

Gowganda.—A wage reduction similar to that put in force at Cobalt was made at the Trethewey. A number of the men refused to accept the cut and left, but most of them returned on learning conditions elsewhere, and the places left open were speedily filled.—Arrangements have been made to resume operations on the Walsh and Silver Bullion properties under one management, with Robert Gamble as superintendent.

Obituary

Dwight B. Huntley died on March 7 at his home in Oakland, following a severe cold caught on the occasion of a recent trip to Grass Valley. He was a graduate of the University of California and a mining engineer formerly prominent on the Pacific Coast. A man of keen intelligence and kindly temperament, he was respected and liked by all who knew him.

Tsunashiro Wada, one of the outstanding figures in the mining industry of Japan and an honorary member of the A. I. M. & M. E., died at Tokyo on December 20, last. As a scientist he is best known for his work in mineralogy and geology; he is the author of a number of books in Japanese and in English, the 'Mining Industry of Japan' and 'Minerals of Japan' being particularly well known. He played a prominent part in the expansion of the Imperial Steel Works at Yawata, in anticipation of the Russo-Japanese war of 1904, for which he received the gratitude of Japan. The list of honorary and official positions that he held includes membership in the House of Peers, a distinction never enjoyed before by a member of the mining profession. As an honorary member of the American Institute he played a prominent part in the reception of visiting members on their tour of Japan in 1911. Professor Wada was 64 years old at the time of his death, and is survived by a wife, four sons, and three daughters.

PERSONAL

The Editor invites members of the profession to send particulars of their work and appointments. The information is interesting to our readers.

J. Mackintosh Bell is in London.

H. A. Thecomb is on his way from Palo Alto to Boston.

Philip Argall has returned from Washington to Denver.

Arthur W. Jenks has gone to Idaho on professional business.

L. T. Pockman, of Los Angeles, was in San Francisco recently.

C. W. Purlington has arrived in London from Eastern Siberia.

E. C. Engelhardt has left Salt Lake City and is now at Denver.

James W. Wade, manager for the Utah Zinc Co., is in San Francisco.

Richard M. Geppert has returned from Los Angeles to Minneapolis.

Walter H. Weed, of New York, was here this week on his way from Arizona.

Frank L. Stack, of the Chile Exploration Co., sailed on March 9 from New York for Chile.

Joseph Errington has returned to Oakland from a visit to the Temiskaming mine, at Cobalt, Ontario.

W. Allen Howard, manager for the United States Smelting Co., at Salt Lake City, has returned from the East.

G. E. Drewitt, recently at Lethbridge, Alberta, sailed from San Francisco on the 'Tahiti' for Sydney on March 3.

G. H. Carnahan, of New York, left there on March 1 for Arizona and Mexico and expects to return early in April.

Jackson A. Pearce has finished his work for the Holo company, in Baja California, and is returning to Berkeley.

C. H. Feldmann has been appointed metallurgist to the Colombian Mining & Exploration Co., and is now in Colombia.

J. R. Buchanan, manager for the Homestead-Iron Dyke Mines Co., Inc., of Homestead, Oregon, is at Pasadena, California.

J. D. Shilling, general superintendent of the Utah Copper mine, has returned to Bingham after two months vacation in southern California.

J. M. Dougherty, construction engineer for the Chile Copper Co., at Chuquicamata, is visiting mining districts in this country. He was in Utah recently.

H. R. Robbins has returned to Fierro, New Mexico, from a two months visit at Minneapolis, supervising ore-tests at the State Mines Experiment Station.

G. G. Brown and H. F. Uttley have formed a partnership as mechanical and structural engineers, and have opened offices at 674 Monadnock building, San Francisco.

H. A. Guess, consulting mining engineer for the American Smelting & Refining Co., is making a tour of inspection of the Chile and Braden properties in South America.

Edward Thornton, heretofore associated with the American Smelting & Refining Co. at Tucson, has been made general manager for the Arizona United Mining Co. at Johnson, Arizona.

William Brand, who for many years past was connected with the Bacis Gold & Silver Mining Co., Ltd., of Durango, Mexico, has resigned from his position as manager, and is now with the Compañia Mexicana de Petroleo "El Agulla" S. A., of Mexico City.

D. H. Angus, formerly manager for the Right of Way Mines at Cobalt, and of the Tough-Oakes Mines, at Kirkland Lake, has been appointed manager for the Bidgood Gold Mines, Ltd., at Kirkland Lake, and the Alpine Silver Mines, Ltd., at Gowganda, Ontario.

THE METAL MARKET



METAL PRICES

San Francisco, March 8

Aluminum-dust, cents per pound.....	65
Antimony, cents per pound.....	6.50
Copper, electrolytic, cents per pound.....	13
Lead, pig, cents per pound.....	4.25-5.25
Platinum, pure, per ounce.....	\$70
Platinum, 10% iridium, per ounce.....	\$100
Quicksilver, per flask of 75 lb.....	\$47.50
Spelter, cents per pound.....	8
Zinc-dust, cents per pound.....	12.50-15.00

EASTERN METAL MARKET

(By wire from New York)

March 7.—Copper is quiet and easy. Lead is more active and firm. Zinc is dull but steady.

SILVER

Below are given official or ticker quotations for silver in the open market as distinguished from the fixed price obtainable for metal produced, smelted, and refined exclusively within the United States. Under the terms of the Pittman Act such silver will be purchased by the United States Mint at \$1 per ounce, subject to certain small charges which vary slightly but amount to approximately three-eighths of one cent. The equivalent of dollar silver (1000 fine) in British currency is 46.65 pence per ounce (925 fine), calculated at the normal rate of exchange.

Date	New York cents	London pence	Average week ending	Cents	Pence
Mch. 1.....	55.75	32.50	Jan. 24.....	66.56	39.94
" 2.....	54.00	31.50	" 31.....	64.52	38.16
" 3.....	54.87	31.87	Feb. 7.....	61.68	36.13
" 4.....	53.50	31.12	" 14.....	61.70	36.32
" 5.....	52.62	30.62	" 21.....	58.81	34.04
" 6 Sunday.....			" 28.....	55.67	32.22
" 7.....	54.37	31.50	Mch. 7.....	54.18	31.52

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.	101.12	132.77	65.95	July	106.36	92.04	.....
Feb.	101.12	131.27	59.55	Aug.	111.35	96.23	.....
Mch.	101.12	125.70	.....	Sept.	113.92	93.66	.....
Apr.	101.12	119.56	.....	Oct.	119.10	83.48	.....
May	107.23	102.69	.....	Nov.	127.57	77.73	.....
June	110.50	90.84	.....	Dec.	131.92	64.78	.....

COPPER

Prices of electrolytic, in cents per pound.

Date	Average week ending		
Mch. 1.....	12.50	Jan. 24.....	13.00
" 2.....	12.50	" 31.....	12.75
" 3.....	12.50	Feb. 7.....	12.87
" 4.....	12.37	" 14.....	13.00
" 5.....	12.37	" 21.....	12.83
" 6 Sunday.....		" 28.....	12.67
" 7.....	12.37	Mch. 7.....	12.43

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.	20.43	19.25	12.94	July	20.82	19.00	.....
Feb.	17.31	19.05	12.84	Aug.	22.51	19.00	.....
Mch.	15.05	18.49	.....	Sept.	22.10	18.75	.....
Apr.	15.23	19.23	.....	Oct.	21.66	16.53	.....
May	15.91	19.05	.....	Nov.	20.45	14.63	.....
June	17.53	19.00	.....	Dec.	18.55	13.18	.....

LEAD

Lead is quoted in cents per pound, New York delivery.

Date	Average week ending		
Mch. 1.....	4.00	Jan. 24.....	5.11
" 2.....	4.00	" 31.....	4.89
" 3.....	4.00	Feb. 7.....	4.79
" 4.....	4.10	" 14.....	4.71
" 5.....	4.10	" 21.....	4.52
" 6 Sunday.....		" 28.....	4.12
" 7.....	4.15	Mch. 7.....	4.06

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.	5.00	8.65	4.96	July	5.53	8.03	.....
Feb.	5.13	8.88	4.54	Aug.	5.78	9.03	.....
Mch.	5.24	9.22	.....	Sept.	6.02	8.08	.....
Apr.	5.05	8.78	.....	Oct.	6.40	7.28	.....
May	5.04	8.55	.....	Nov.	6.76	6.37	.....
June	5.32	8.43	.....	Dec.	7.12	4.76	.....

TIN

Prices in New York, in cents per pound.

	1919	1920	1921		1919	1920	1921
Jan.	71.50	62.74	35.94	July	70.11	49.29	.....
Feb.	72.44	59.87	32.16	Aug.	62.20	47.60	.....
Mch.	72.50	61.92	.....	Sept.	55.79	44.43	.....
Apr.	72.50	62.17	.....	Oct.	54.82	40.47	.....
May	72.50	54.99	.....	Nov.	54.17	36.97	.....
June	71.83	48.33	.....	Dec.	54.94	34.12	.....

ZINC

Zinc is quoted as spelter, standard Western brands, New York delivery, in cents per pound.

Date	Average week ending		
Mch. 1.....	5.10	Jan. 24.....	5.96
" 2.....	5.10	" 31.....	5.42
" 3.....	5.10	Feb. 7.....	5.40
" 4.....	5.10	" 14.....	5.41
" 5.....	5.10	" 21.....	5.35
" 6 Sunday.....		" 28.....	5.20
" 7.....	5.10	Mch. 7.....	5.10

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.	7.44	9.56	5.86	July	7.78	8.18	.....
Feb.	6.71	9.15	5.34	Aug.	7.81	8.31	.....
Mch.	6.53	8.93	.....	Sept.	7.57	7.84	.....
Apr.	6.49	8.76	.....	Oct.	7.82	7.50	.....
May	6.43	8.07	.....	Nov.	8.12	6.78	.....
June	6.91	7.92	.....	Dec.	8.69	6.03	.....

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, according to quantity. Prices, in dollars per flask of 75 pounds.

Date			
Feb. 8.....	50.00	Feb. 22.....	47.50
" 15.....	50.00	" 28.....	47.50
		Mch. 8.....	47.50

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.	103.75	89.00	50.00	July	100.00	88.00	.....
Feb.	90.00	81.00	48.75	Aug.	103.00	85.00	.....
Mch.	72.80	87.00	.....	Sept.	102.60	75.00	.....
Apr.	73.12	100.00	.....	Oct.	86.00	71.00	.....
May	84.80	87.00	.....	Nov.	78.00	56.00	.....
June	94.40	85.00	.....	Dec.	95.00	52.50	.....

TARIFF REVISION

A complete understanding of today's world-trade situation, uninfluenced by any provincial or political views, must guide the course of the tariff legislation now pending before Congress if the United States is to benefit in full measure from her position as creditor nation of the world, according to the current issue of 'American Goods and Foreign Markets', the international trade survey of the Guaranty Trust Co. of New York. The bank emphasizes the dangers of plans which imply commercial isolation, and of temporizing devices which propose to hamper the free world-wide movement of the great staple raw materials and food products. It says, in part:

The Emergency Tariff Act that has passed both the House and the Senate at the present session, but seems not likely to become a law, cannot be said to reflect any clear appreciation of the present world situation and the new relations which the United States now holds in international trade and finance. At a time when vast debts are owed by foreign countries to the United States—debts that are so great that the possibility of payment in gold is out of the question—it is a matter of concern that it should be seriously proposed to erect additional heavy barriers to such payment as might be made through the importation of foreign raw materials, food products, and manufactured commodities.

While the unfortunate position of holders of agricultural products, in whose behalf this legislation is chiefly urged, may be fully recognized, it is still difficult to see in what respect the imposition of tariffs can help them materially; while it is certain that the effect upon the welfare of the nation as a whole cannot fail to be seriously adverse. There is no certainty whatever that domestic markets can be stimulated by tariff exclusion of foreign goods, nor that domestic prices will thereby be appreciably enhanced. If Canadian and Argentine wheat, for example, are excluded from the United States, it is clear that this surplus will then compete in foreign markets with our own wheat exports, with a resulting disadvantage to that trade which would probably offset any supposed advantages gained in the domestic market. The chilling effect of the loss of foreign markets upon our domestic industries will certainly be reflected in a lessened demand for our raw materials here, and this in turn will tend further to depress the prices received for such materials.

Of course, the industries of the United States must be protected from unrestricted floods of imports arising from the inequalities of wages and depreciated exchanges. Security from these cheap foreign costs cannot be derived from any single all-inclusive tariff; it might be found in a more flexible arrangement, by treaty or otherwise, which would equalize the selling prices of varied foreign goods in our markets.

With all the wonderful advantages possessed by the United States as compared with any other country, there is little excuse for reliance upon such temporizing devices as are often proposed in plans to hamper the free world-wide movement of the great staple raw materials and food products. With thrift and energy applied to the situation today the present difficulties can readily be overcome within a reasonable period of time. We should surely hesitate before arousing the resentment of the entire world by adopting plans which imply commercial isolation, and which must eventually react to our decided disadvantage.

MONEY AND EXCHANGE

Foreign quotations on March 8 are as follows:

Sterling, dollars:	Cable	3.89%
	Demand	3.90%
Francs, cents:	Cable	7.20
	Demand	7.23
Lire, cents:	Demand	3.71
Marks, cents:		1.64

Eastern Metal Market

New York, March 2

Conditions do not improve and the future is not as bright as a few weeks ago. There is almost no buying of any of the metals except perhaps tin.

Prices for copper have again fallen because of no buying support.

On a falling market tin has been bought in fair amounts.

The lead market has again declined to new low levels; inquiry as a result improved.

There is still no life to the zinc market.

Antimony is unchanged.

IRON AND STEEL

The February output of pig-iron, 1,937,257 tons compared with 2,416,292 tons for the 31 days of January, was 8758 tons less per day than in January, according to 'The Iron Age'. The daily average of 69,187 tons was the smallest for six years save for two months in 1919. There was a net loss of 30 furnaces in the month, the number active on March 1 being 153 and the number active on February 1 being 183. Seven furnaces were blown-in, but 37 in all blown-out or banked. The estimated production rate of the 153 furnaces on March 1 is 61,850 tons.

Buying has been limited to bare needs and the stagnation resulting from the price-cutting has not yet been broken. While independents generally appear to have booked sufficiently to maintain their recent scale of operations, further recessions in Steel Corporation plant activities more definitely tell the story.

COPPER

The tone of both major and minor copper markets is weaker. The improvement, which was expected to set in after the financing of the large surplus stocks, has not materialized. Buying is on an extremely small scale both for domestic and foreign account. Electrolytic copper is quoted at 12.50 to 12.75c., delivered, for prompt and early delivery, with 12.62½c. asked for April and 12.75c. for second quarter. Lake copper is quoted at 12.75 to 13c. for the same positions. Feeling among many of the producers is not cheerful. Much depends on the outcome of the European tangle.

TIN

The week has witnessed two periods of buying spurts. Last week Thursday there was a fairly active demand from dealers for future shipment (March and March-April) at around 33c., total sales amounting to about 250 tons. On the next day there was moderately heavy buying, totaling 500 to 700 tons, also by dealers, on a sharp decline in prices. This fall was due to the announcement, confirmed quickly, that the Malay government had removed its minimum price of £203 at which it would buy tin from producers. This resulted in a sharp slump in all markets here and abroad. The report was accompanied with the statement that the Straits authorities would hold its accumulated tin until it could part with it without a loss. Opinion on far Eastern developments here was to the effect that this would hold in check any further rise in this market. This resulted in the buying referred to which was put through at 32.50c. down to 31.50c. Spot Straits has been largely neglected, there being few sellers. The disposal of odd lots has tended to hold the price down. The quotation yesterday for spot Straits had receded to 30c., New York, against 32.50c. on February 21. The London market yesterday was down £12 to £14 per ton from the quotations of February 21 or £158 for spot standard, £162 for future standard and £173 for spot Straits.

There have been no developments on the tariff matter. There is a prospect that the first step will be a revival of the

Payne-Aldrich tariff and that tin will continue on the free list until autumn and that it will take a year or more to perfect or enact a new tariff law.

Tin statistics for February show 1585 tons delivered into consumption with 3546 tons in stock and landing on February 28. Imports to March 1 were 3830 tons as contrasted with 9415 tons to March 1, 1920. There are 1535 tons reported afloat.

LEAD

Because of sharp recessions in prices again the past week and because the metal is looked upon as cheap, there has been a marked revival in inquiry mostly from speculative interests. The American Smelting & Refining Co. reduced its prices twice last week—to 4.20c. on February 24 and to 4c. on February 25, both New York and St. Louis. The outside market had reached this level also and is now 4c., New York, and 3.90c., St. Louis. The market in London has also fallen, which has been a factor because of the possibility of further imports which any further decline there would insure. There has been considerable contraction in Western mining operations which may reduce supplies here, making possible the taking-up of the 'slack' by foreign lead, of which there is an ample supply.

ZINC

There is no improvement in this market either as to demand or sentiment. Buying is confined to hand-to-mouth needs. Prime Western for early delivery is quoted at 4.75c., St. Louis. This means 5.25c., New York, for the domestic alloy, with imported metal quoted at 5.10c., seaboard, but this cannot compete with domestic metal at interior points. It is reported that some feel the bottom of the market has been reached, but there have been similar sentiments before, only to be disappointed.

ANTIMONY

There has been no change in conditions and quotations for wholesale lots for early delivery remain at 5.20c., New York, duty paid.

ALUMINUM

The leading producer continues to quote 28c. f.o.b. plant, for wholesale lots for virgin metal, 98 to 99% pure, while other sellers are asking 23.50 to 24.50c., New York, for the same grade.

ORES

Tungsten: There are no reported developments. Demand is absent and quotations remain nominal at \$2.75 to \$3 per unit. Ferro-tungsten is quoted at 58c. per pound of contained tungsten in guaranteed material.

Molybdenum: There is no interest in this mineral, the quotation being nominal at 50c. per pound of MoS₂ in regular concentrate.

Manganese: High-grade foreign ore is nominal at 35c. per unit with no demand in sight. Consumers are provided amply with stocks on contracts. A cargo on the seas is reported offered at 30c., seaboard.

Manganese-Iron Alloys: Both ferro-manganese and spiegeleisen are in small demand, quotations being nominal at \$35, furnace, for spiegeleisen and \$92 to \$95 delivered, for American ferro-manganese with the British alloy at \$100, seaboard.

During the first 10 days of February, \$730,497 worth of silver was shipped to Great Britain, \$1,707,665 to China, and \$302,198 to Japan. Imports include \$1,386,780 from Mexico and \$358,473 from Chile.



T. A. RICKARD, Editor

THE 'base' metals are coming into their own in Central Europe, and a use has been found for them that should provide interesting material for publicity experts. The 5-pfennig German coins are now made of iron; the 10-pfennig, of zinc; and the 50-pfennig, of aluminum.

FURTHER litigation has been started by the Minerals Separation company, the defendants in the suits being the Utah Copper, Ray Consolidated, Chino, Arizona Hercules, and Ray Hercules companies, as well as Mr. J. M. Callow and the General Engineering Company of Salt Lake City. The contention against the General Engineering Company is that this defendant is a "contributory infringer" because it sells machines wherewith the others infringe the Minerals Separation patents. The suits against these companies have been started variously in Maine, New Jersey, Arizona, and Utah. The patents involved are those covering 1% of oil and soluble frothing-agents, as in the suits still pending, namely, those against the Miami, Butte & Superior, Magma, and Nevada Consolidated companies.

A FREQUENT suggestion is seen in the correspondence columns of our daily press that we should purchase Canada or some of the West Indian islands from Great Britain, taking the territory in part or whole payment of the amount owed in respect of War loans. Our contemporary, the 'Canadian Mining Journal', makes the pertinent suggestion that it might help to clear the viewpoint of those who consider the suggestion within the realm of practical politics that they would first endeavor to explain how a similar policy could be carried out by the United States. Suppose, for instance, that we decided to sell California, how would—but enough has been said to indicate the absurdity of the idea and the logic in the contention of our contemporary across the unfortified border that divides two peaceable countries.

PORTLAND, the city of roses, is to be the scene of the third annual International Mining Congress on April 5 and the four following days. An excellent program is promised, and, what is more important, a representative attendance of mining men from the North-West is assured. This convention is one of the best because it gives an opportunity for Canadians and Americans to foregather in neighborly fashion. The first meeting was held at Vancouver in 1919, and it was well supported by

the mining people of Seattle and Spokane; the second meeting was at Seattle last year, and Vancouver sent a large delegation; this year it is to be at Portland, and we are informed that the Vancouver and Seattle folk will attend in force. We like the north-western conventions because they bring together the men of Alaska, British Columbia, Washington, Oregon, northern Idaho, and western Montana, representing a co-operation of the English-speaking peoples that is of good augury for peaceful industry and the safe-guarding of our civilization from the intolerable menace of war. We advise our readers to make an effort to go to the convention at Portland, believing that they will find it worth while.

ON April 6, at Jersey City, the American Smelting & Refining Company holds its annual meeting, which this year promises to be of unusual interest owing to the contest between Mr. Karl Eilers and the Guggenheim family. We have published the circulars issued by the two sides in this controversy, so that our readers could inform themselves concerning the points at issue. We note that Mr. Eilers has inserted advertisements in the New York papers asking for proxies. Whatever the result, we believe that the action taken by Mr. Eilers will do good not only to the Smelting company but to other large corporations in that it will serve to remind those in control, the directors, that they are trustees as well as privileged stockholders. Minorities are habitually disregarded by the powerful groups that control our principal industrial enterprises and it was well that they should be reminded of their obligations to *all* the stockholders, not to their friends only.

DIVIDENDS paid for 1920 by the gold-mining companies operating on the Rand aggregate £8,312,467, which compares with £6,401,992 on account of 1919, and the record of £8,887,185 in 1910. Ten years ago the average so-called working cost was 17s.6d. per ton, as compared with 25s.9d. in 1920. These figures are useful for comparison, but it must be noted that the actual cost of mining, to be deducted from the value of the output before the profit is distributable, is from 20 to 35% greater than the fictitious and conventional statistics to which we have made reference. In 1910 the 'profit' was given officially as £11,216,105. However, the most important feature of last year's highly successful operations is the effect of the so-called premium on gold, whereby an av-

erage of 7 shillings per ton was gained in terms of paper currency. During 1920 the excess of realization on the sale of gold over the normal price, of 85 shillings per ounce, aggregated 28,500,000, which is £200,000 more than the total of dividends. This would seem to indicate that the average profit of the mines would disappear if the paper pound sterling were to be restored to its pre-war value in terms of gold, but, as a matter of fact, such a return to normal would cause the poorer mines to shut down, without killing the richer ones, whose profits, however, would suffer considerably. In 1919 the credit from the 'premium', for all the mines of the Rand, was only £3,685,000. The New Modderfontein, for 1920, distributed dividends of £1,135,000, or £455,000 more than in 1919. Of the total output, 62½% came from the mines of the Eastern Rand, where further developments of a satisfactory nature are recorded, as contrasted with the older part of the district, the Central Rand, where the exhaustion of the older mines and the non-persistence of rich ore are marked features.

A JURY of twelve of the leading editorial writers on newspapers in twelve of the larger cities has decided that the "best edited" newspapers in the country are the 'Boston Transcript', 'New York Times', and 'Chicago Tribune'. We would have placed the 'New York Times' in a class by itself. The criterion was "the best editorial pages", meaning presumably the most interesting, truthful, and incisive editorial comment and criticism. The 'Transcript' is too narrow in spirit to be rated so highly, and the 'Chicago Tribune' made too many blunders during the War period to be considered a trustworthy organ of opinion. Not one of the Hearst papers was mentioned among the twelve leading newspapers of the country; and this reminds us that the 'Seattle Post-Intelligencer' has recently become a tentacle of the Hearst octopus; the paper has deteriorated of recent years, and now meets a miserable fate. We do not know exactly how many papers Hearst controls, but we suggest again that it is contrary to democratic ideals that he should be permitted to exert an influence so widespread, so mean, and so malicious.

IN this issue we take pleasure in publishing the first of a series of three articles on placer mining in Russia. The author, Mr. L. A. Perret, well known on account of his long and honorable connection with Russian mining, was at one time general manager of the Shonvaloff platinum mines and, later, of the Lenskoie property of the Lena Goldfields company. Though a Russian mining engineer by education, having graduated from the Petrograd Mining Institute, he is of French origin, as his name indicates. His experience has been extensive; he erected the first gold dredge in Russia in 1894, and he is particularly well qualified to speak on placer-mining practice in that country. The series, which has been written primarily to combat unfavorable opinions with regard to Russian mining methods, will be found to contain a wealth of information. Some of Mr. Perret's conclusions and remarks, we expect, will not escape contradiction by

those with whose opinions he is at variance, namely, our friends Messrs. C. W. Durrington and J. P. Hutchins. However, we welcome criticism of a constructive nature; we agree with Mr. Perret that it is one of the elements of progress. In subsequent issues he deals with the drifting and timbering methods in use in Siberia, he justifies the use of the horse-whim in certain cases, emphasizes the size of Russian operations, outlines improved Russian practice, and deplors the introduction of the Alaskan sluice, giving data in support of his contentions. It is maintained that the tailing-heaps resulting from Russian operations are not rich in gold, as foreign critics would have us believe; and disaster is foreseen if capital is invested, without adequate investigation, for the erection of re-treatment plants. Prospecting is an important preliminary to mining operations; Russian methods are certainly cheap and are said to be efficient. Dredges of light construction are to be preferred; foreign engineers have as yet failed to appreciate the difficulties of transport in Siberia, so says our writer. Safety measures and welfare regulations, he states, are enforced by law; the cost incurred thereby and the need for extraordinary expense in other directions make placer mining an industry in which efficient and economical operation is essential. Mr. Perret's articles will prove of interest and value; whether the performance of the Russian miner will ever again reach the pre-war standard may be open to question, but it is evident that all the requirements for successful exploitation are available in Russia when conditions become normal. We share Mr. Perret's hope that capital and a sympathetic consideration for local conditions will then be forthcoming.

THE annual report of the Department of Mines of South Africa contains a statement of fact by the Inspector of Mines for the Krugersdorp district that focuses attention on the subject of shift-bosses and their treatment by those in charge of underground operations. It is pointed out that there is a great scarcity of qualified mine officials, including superintendents, overseers, and shift-bosses. The shift-bosses are usually promoted to the higher positions, so that the subject is of importance. The substance of the Inspector's report is that the shift-boss receives inadequate support from his manager. If he is keen on his work, carries out his duties conscientiously, and reports all contraventions of regulations, it frequently happens that the men approach the manager and threaten to strike unless he is removed. Few of the managers, it is averred, have the courage to stand up for their immediate subordinates; several capable shift bosses have been removed from their positions without just cause, the fear of a strike and censure in subsequent investigations dominating the action of the executive. We concur with the Inspector's contention that if the word of the shift-boss cannot be taken as final on a matter of this sort, something is wrong. Nothing needs more emphasis in some organizations than the truism that loyalty should be reciprocated by those who demand it; the shift-boss will always be sure of a square deal when managers realize this. Our contemporary in South Africa, the

'Mining and Engineering Journal', thinks that the greater moral support of the shift-boss should be accompanied by increased remuneration. Just as the backbone of the army lies in its non-commissioned officers, so does the backbone of a mine depend on its shift-bosses; and the leaders of the industry will take a big step in the direction of improved efficiency if they will make the billet of the shift-boss more attractive than it is at present, giving less attention to the chasing of economic and industrial will-o'-the-wisps. One good shift-boss, adds our contemporary, is worth at least half a dozen venerable old gentlemen who sit on the boards of several companies and whose sole function in life appears to be the seconding of resolutions and the signing of checks. The mine-managers of the future are the shift-bosses of today; it should be realized that so long as they hold their positions because of service, zeal, and integrity, they should have the unswerving support of their superiors in any matter of dispute between them and the employees over whom they exercise control. Their pay should be commensurate with the responsibility of the positions they occupy.

BROKEN HILLS stock has been less conspicuous recently on our local exchange, probably on account of the disciplinary action of the Commissioner of Corporations. We have had little to say about this flamboyant promotion because the antics of George Graham Rice do not interest our readers seriously, but somebody has sent us a copy of a report dated February 28, signed by Mr. Arthur Perry Thompson, and it provokes us to comment. The word 'high-grade' appears at least 28 times in this short report, as if to illustrate the idea that if you say a thing often enough it will be believed by nine persons out of ten. We note that the mining operations incidental to the removal of this rich ore are termed 'high-grading', which in the West is a word synonymous with the stealing of ore. "Strong clay walls", whatever these may be, are mentioned as the marks of "deep-seated enrichment". The gentleman probably refers to a thick clay selvage, which is not a proof of deep-seated enrichment, but only of intense attrition. The report is meretricious in style, being full of vague allusions to potential wealth and forecasts of orebodies yet to be found, all couched in pseudo-scientific language. "Indications in the shaft point to the existence of other orebodies in the immediate hanging-wall and foot-wall country with even higher grade ore contents." This is piffle. "An undetermined further width of vein in the foot-wall of the shaft adds greatly to the possibilities of a large stoping width of ore at that level." So do the potentialities of wealth untested and unknown under the icefields of the South Pole. "The intense mineralization extends into the sides of the drift, indicating not only a positive stoping width of ore greater than the width of the 3½-ft. drift, but also a most favorable hanging-wall country in which similar parallel veins are likely to be found." This indicates an intensive use of flapdoodle for the purpose of impressing ignorant persons. "At last advices, the same core of high-grade ore assays \$122 per ton."

The report is dated at the mine; what later news did he expect? The phrase "at last advices" is plainly a piece of bunk. "The occurrence of black silver-lead sulphides in quantity at this point in the Belmont vein, similar to the high-grade ore of the main Broken Hills vein, is most encouraging and strengthens the belief that these two veins are members of one northwesterly vein system which, particularly as depth is gained, will prove to be the locus of much of the enrichment on the property." The occurrence of pink silver-lead sulphides might have justified this rhetorical rot, but we surmise that "the system" is more likely to prove the seat of hocus-pocus than the locus of secondary enrichment; indeed, the dabblers in stock may find themselves the victims of an ancient leaching process whereby gold is concentrated from the pockets of the many into those of the few.

The Valuation of Mines

In this issue we add one more to the many useful articles on mine valuation that Mr. Morton Webber has contributed to our pages. On this occasion he discusses the appraisal of idle and depleted mines. There was a time, in the days of our fathers, when mines were bought on their records of past achievement; the folly of inferring that the past yield of a mine is a reliable index of its probable future production was exposed in due course, only to be followed by the placing of an excessive emphasis on ore-reserves, based on an erroneous idea that the ore to be developed must necessarily be proportional in tenor and tonnage to that already proved. To buy blocks of ore at a high price was hardly less foolish than to buy empty stopes for a small sum of money; and neither could serve as the basis for a healthy mining venture. Mr. Webber considers the evidence that is available to the examining engineer when a mine is either partly or wholly inaccessible. We agree that a small dump at the shaft and a large one below the mill are good signs, as indicating that the proportion of waste hoisted to the surface was small. Of the reasons given for stopping operations, one is usually as good as another; the chief point to keep in mind is that the cessation of work was probably due to the fact that the mine did not pay under the conditions existing at the time. Only in rare cases, the consequence of abnormal circumstances, is a profitable mine shut-down. The chief inducement to re-open an idle mine is found in the fact that a higher price is obtainable for the metal it produces, or because the introduction of more efficient technical methods increases the recovery. The stope-filling of yesterday may be the ore of today; the refractory mineral of a past decade may prove docile to a new process. Occasionally, if good maps and stope-sections have been kept, it is possible to check the alleged output by computing the cubic contents of the ground excavated. In other cases the alleged tonnage put through the mill can be checked by measurement of the tailing. The careful examination of even a part of the old workings will indicate the relation between the thickness of the lode and the width of the stopes, thereby giving a clue

to the degree of selection and sorting that was practised before delivery of the ore to the mill or smelter.

Such general considerations, however, are less useful than concrete examples. Mr. Webber quotes two; we are able to quote two more of recent date and not far from home. The Metals Exploration Company, under the leadership of Mr. Bulkley Wells and acting on the advice of Mr. Fred G. Farish, has started to re-open the Idaho-Maryland, a consolidation of four mines at Grass Valley, California. This property is credited with a total output of \$18,000,000 in gold. It was operated until 1901, at which date the extension of irregular workings, through an inclined crooked shaft reaching a vertical depth of 2181 feet, had exceeded the capacity of the hoisting and pumping equipments. An orebody, with a maximum horizontal length of 1400 feet on a pitch of 30°, had been exploited unsystematically and no exploratory work had been done outside this one orebody. The enterprise came to grief. Before closing down, the owners took the precaution of inviting a number of reputable men underground, including the mayor of the town and several local mine-managers, among whom Messrs. George W. Starr and Charles A. Brockington may be mentioned. These were shown that the closing of the mine was not due so much to lack of ore as to the bad condition and inadequate scope of the equipment. The evidence thus recorded became available to Mr. Wells and his associates. In order to operate the mine properly it is necessary now, as it was then, to sink a new shaft, otherwise it would be impracticable to supply the tonnage for a mill of any size; meanwhile the old shaft is being used for unwatering the workings and for exploratory purposes.

Another enterprise of a similar character has been started on the Comstock by the same engineers in the name of the United Comstock Mines Company. Control has been acquired over 7000 feet of the lode, including the old Overman, Beleher, Crown Point, Yellow Jacket, Confidence, Imperial, and Alpha mines. The old workings had been re-opened and examined previously under the direction of Mr. Alexander Wise on behalf of a syndicate headed by Mr. Herbert Humphrey; the fills had been sampled, as well as all faces in anything that looked like ore; moreover, new cross-cuts had been extended through the lode from wall to wall. The conclusion reached was that there was available 2½ million tons of filling and of ore too low-grade for extraction under the old regime. It is estimated that this material averages about \$6 per ton, in gold and silver. An ore of such assay-value is good enough to yield a profit when exploited under improved conditions, which include better and cheaper metallurgic methods, as well as a lower cost for mining. A new adit, 9000 feet long at a depth of 700 feet below the outcrop, will give convenient access to this part of the Comstock lode. Modern drilling machines, together with the introduction of the caving system, are expected to help in changing the economic status of the low-grade material left in these mines by their former owners. Much ground remains unexplored and offers inducement to the search for virgin orebodies. No records of past

production are included in the evidence, that of the sampling and assaying of the stopes and ends being considered sufficient to justify the undertaking. In both cases, at Grass Valley and at Virginia City, the conditions are reasonably promising, and careful investigations appear to warrant the speculation, because the prospect of winning is proportioned to the risk. After all, that is the chief factor to be considered. Is the 'ante' too big for the game or is it not? Mining operations of this kind are less of a gamble than poker and less of an investment than Liberty bonds; they represent a healthy speculation, in which a large gain may be won at the risk of a comparatively small loss. That is the essential feature of a sane mining venture.

The Panama Tolls Dispute

Any action that will result in encouraging the American merchant marine should receive prompt consideration. We are concerned, to a larger measure than is realized at the present time, in increased traffic with our South American neighbors; and we should, therefore, possess an indisputable right to foster and encourage American intercourse by any and every means possible: to increase and cheapen the freight on imported raw material, such as copper, nitrate, oil, and iron ore, and to develop the South American mining industry with the help of both capital and engineers from the United States. The fact remains, however, that we have no clear right to adjust the tolls for our own ships passing through our own canal at Panama, because of the Hay-Pauncefote treaty of 1902, the interpretation of which is still in dispute.

The history of the conflict in Isthmian interests between the United States and Great Britain commenced about the middle of the last century. At that time Great Britain had an extensive interest in Central America. In addition to the colonies of British Guiana and British Honduras, she had island settlements, and she exercised nominal control over a large part of Nicaragua, as ally and protector of the Mosquito kingdom. In 1849, the United States chargé d'affaires there obtained a concession from the Nicaraguan government to build a canal across the isthmus, in return for a guarantee of American protection of the independence of that country. This concession, consummated in the Hise-Helva treaty, was in direct defiance of Great Britain's rights, because the canal would have passed through land under British control. The American representative's action was disowned in Washington, the treaty was never ratified in the Senate, and Hise was recalled. Further attempts were made by his successor to obtain a concession of coastal territory then under British control, by negotiation with Nicaragua. Great Britain lodged a strong protest, and acute tension resulted. The United States then decided to recognize British interests on the Nicaraguan coast, in the form of an international agreement between both parties that would permit the construction of a ship-canal. The treaty, known as the Clayton-Bulwer treaty of 1850, was drawn up between John M. Clayton, Secre-

tary of State, and Sir Henry Lytton Bulwer, British Ambassador to the United States. The "great design" of this treaty was to permit the construction and maintenance of a canal as "a ship communication between the two oceans for the benefit of mankind on equal terms to all". In sending this treaty to the Senate for ratification, President Taylor made mention of the fact that at the time of the discussion of the matter Great Britain was in nominal control of nearly half of Central America, as ally and protector of the Mosquito kingdom. The President also stated that, "It has been my object in negotiating this treaty to secure the passage across the Isthmus to the Government and citizens of the United States by the construction of a great highway dedicated to the uses of all nations on equal terms." At this stage two points were evident, since admitted by American authorities: the acknowledgment of the rights of Great Britain in Central America, and the initiation on the part of the United States of a policy, which has since become traditional, that the canal should be dedicated "to the use of all nations on equal terms".

The Clayton-Bulwer treaty was more or less of a diplomatic triumph for Great Britain; the United States realized this and sought an end of European influence on the Mosquito Coast. Pressure was brought to bear, with the result that Great Britain was induced to give back to Nicaragua her entire independence, on the understanding, however, that active objection would be made should Nicaragua permit domination by any other power. In 1869, the United States made a treaty with Colombia for the right to build a canal, but the project was dropped. Colombia then saw that she possessed a realizable asset; and overtures were made to Europe. A few years later, the achievement of De Lesseps in the construction of the Suez Canal again drew attention to the possibility of ship communication between the Atlantic and the Pacific. A congress was held in Paris in 1876 at which De Lesseps was chosen chairman. A sea-level canal was decided upon, the cost was estimated at \$240,000,000, and the work was commenced in 1882. The venture was doomed to failure from the start. The general scheme was impracticable from the engineering standpoint: disease and the absence of preventive measures resulted in a high death rate. The work done was carried out under great difficulties: mistrust, dishonesty, and graft were rampant, and every imaginable obstacle seemed to arise to balk the purpose of those who had embarked on a scheme of such magnitude. In 1887, De Lesseps returned to France and resigned. He was tried for embezzlement of funds, from which charge he was honorably acquitted. But the complete failure of the canal scheme preyed on his mind to such an extent that he became insane, and he died in 1894. The work of the French in the canal-zone resulted in the loss of thousands of lives and the removal of about 80,000,000 cubic yards of earth at a cost of about \$250,000,000. Only 28,000,000 yards of this excavation was of value to their successors, who eventually had to remove ten times this amount in the construction of a canal of practicable design.

American interest in the Isthmian waterway was quickened when France took a lead in the matter in 1876. Several alternative routes were available; and it was seen that grave objections would be made because the Panama canal, if built by the French, would be under European and not under American control. Communications passed between the United States and Great Britain before De Lesseps started work. James G. Blaine, then Secretary of State, pointed out the strategic importance to the United States of any Central American canal. In writing to James Russell Lowell, our ambassador in London, under date June 24, 1881, he said: "In times of peace, the United States does not seek exclusive privileges for American ships in respect to precedence or tolls through an inter-oceanic canal, any more than it has sought like privileges for American goods in transit over the Panama railway under the control of an American corporation." In a letter dated November 19, 1881, he was even more explicit in stating that the United States did not seek any exclusive or narrow advantage. "It frankly agrees," he continued, "and will by public proclamation declare at the proper time in conjunction with the republic on whose soil the canal may be located, that the same rights and privileges, the same tolls and obligations for the use of the canal, shall apply with absolute impartiality to the merchant marine of every nation on the globe." This correspondence indicates an adherence to the traditional policy of the United States, that the canal should be dedicated to the use of all nations on equal terms, the words "all nations" being clearly equivalent to "every nation on the globe". It also showed that, with regard to treaty or other obligations, it was immaterial as to where the canal should be situated.

In 1898 the immense value of a ship-canal through the Isthmus was realized by the United States, as a result of the fact that, during the Spanish-American war, the 'Oregon' was obliged to travel 13,400 miles to reach the Atlantic, instead of 5000. The Clayton-Bulwer treaty still remained in force, and much dissatisfaction was expressed on this account. In 1900 Great Britain was approached with a view to its modification. The Hay-Pauncefote treaty resulted, and was ratified by the Senate on February 21, 1902. The significance of the substitution was emphasized by Mr. Elihu Root in a speech made on November 21, 1912, in which he recalled that "a new agreement was made under which Great Britain retired from her position, and signed over to the United States all the rights she had under the partnership agreement, with the provision that the canal when constructed under the patronage of the United States, or by the United States, whichever it might be, should be opened and made neutral upon the same terms that were specified in the original agreement, which were that the ships of Great Britain and the ships of the United States should have exactly the same treatment". To be more precise: the Hay-Pauncefote treaty was a mutual agreement between the two countries with reference to the construction of a canal, "without impairing the general principle of neutralization established in Article VIII of

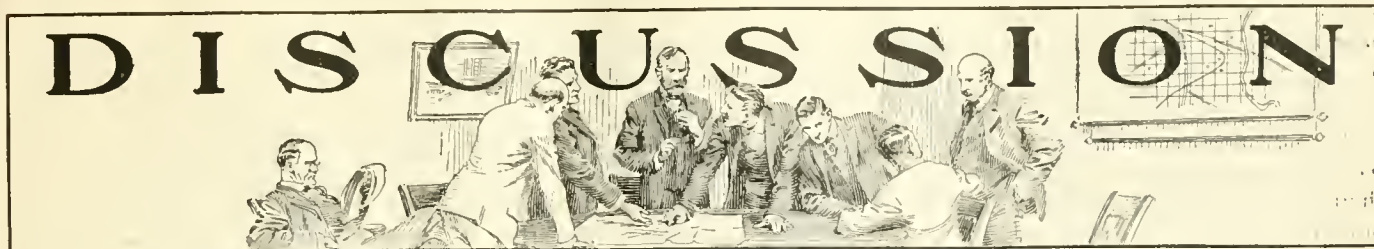
that convention", namely, the Clayton-Bulwer treaty of 1850. Article VIII of the Clayton-Bulwer treaty contains the following passage: "In granting, however, their joint protection to any such canals or railways as are by this article specified, it is always understood by Great Britain and the United States that the parties owning or constructing the same shall impose no other charges or conditions on traffic thereupon than the aforesaid governments shall approve of as just and equitable, and that the said canal or railways, being open to the citizens and subjects of Great Britain and the United States on equal terms, shall also be open on like terms to the subjects and citizens of every other state which is willing to grant thereto such protection as Great Britain and the United States engage to afford." Article III of the Hay-Pauncefote treaty states that: "The canal shall be free and open to the vessels . . . of all nations observing these Rules, on terms of entire equality, so that there shall be no discrimination against any such nation."

If, from a clear conception of the traditional policy of the United States and after a study of the available evidence, the words "all nations" are construed to mean "every nation on the globe", then it must be admitted that we violated the treaty by an Act of Congress that gave free transit to American ships engaged in coast-wise traffic. Belief is expressed in some quarters that "all nations" means "all nations except the United States". To provide against friction arising from the doubtful interpretation of treaties, however, the United States and Great Britain agreed, in a treaty dated April 4, 1908, that "differences which may arise of a legal nature or relating to the interpretation of treaties existing between the two contracting parties and which it may not have been possible to settle by diplomacy, shall be referred to the Permanent Court of Arbitration established at The Hague". But the United States, though favoring arbitration in principle, especially to settle disputes of this nature, was disinclined to accept it in this instance. The reason may be found in a speech of President Taft on January 4, 1913, in which he remarked, "A good many people are saying, 'Don't arbitrate, because you are going to lose'." He proclaimed a disagreement with the view as to the probable result, but still he abstained from acceding to the British request for arbitration, giving as a reason that the question might yet be solved through diplomatic channels. And that is how the matter stands at the present time. A large proportion of our population is being educated by a section of the press to believe that the Hay-Pauncefote treaty was an underhand and immoral move on the part of Great Britain, rather than, as appears to be the case, the compensation for the relinquishing of important interests in Central America. Some critics have argued that Great Britain held the Mosquito region illegally and by unjust intervention; but it is too late in the day to bring forward such a feeble argument. The control by Great Britain of a considerable portion of Central America was admitted by a President of the United States; and the treaties drawn up in full cognizance of this fact were

agreed to by United States representatives and ratified by the United States Senate.

The Hay-Pauncefote treaty stands today as a hindrance to the development of our merchant marine. The traditional policy of the United States, as interpreted by treaties and the letters and speeches of American statesmen, should be changed. A young nation with none of the colonial or tropical experience of Great Britain has succeeded in connecting the two oceans for maritime traffic. The laborer is worthy of his hire; and the United States should and will be the first to benefit from an expenditure of money and an exhibition of technical and administrative ability that ranks high in the annals of human achievement. The time has come when a new policy must be proclaimed: that the same tolls and obligations for the use of the canal shall apply with absolute impartiality to the merchant marine of every nation of the globe, except that of the United States. We must be free to protect our merchant ships from competition with those of countries where the standard of living is lower than it is here. We must be free to act without breaking faith. It is absurd to claim, as some do, that the United States is only exerting its sovereign right in adjusting the tolls as she thinks fit; for the treaty stands in the way, and it is well known that we had no sovereign rights in Central America when it was drawn up. Four courses are open: to interpret the treaty in accordance with the traditional policy of the United States, by the adoption of an absolutely impartial toll-rate for the merchant marine of every nation on the globe, including that of this country; to disregard it; to submit the matter to arbitration; or to take definite action and to vote a compensation to Great Britain in return for her agreement to the abrogation of the treaty.

We favor the last-mentioned course; we believe that it would be against the interests of our country at the present time to forego that preference to American shipping needed to permit expansion overseas, particularly in connection with South American industry. We have a reputation for fairness; the Hay-Pauncefote treaty cannot be rejected as a "scrap of paper". It is doubtful whether arbitration is suitable at this stage; the result would seem to be a foregone conclusion if the interpretation of the treaty were adjudged before an impartial tribunal, and the main problem would still remain unsolved. We suggest the annulment of the treaty; and, as compensation to Great Britain, the cancellation of a part of her war debt to us. The treaty discriminates against the country that built the canal, and is therefore inequitable. How much of British interest in the treaty was due to diplomatic acumen and how much was due to the relinquishing of important spheres of influence in Central America is open to question; but one thing is certain: the treaty is one of Great Britain's assets and should be considered as such. A fair price should be proposed. Whether it were accepted or refused after adequate discussion or modification would not alter the subsequent course of action; we would have the right to adjust tolls as we thought fit, favoring our own merchant marine in any way found desirable.



Mining in Dutch Guiana

The Editor:

Sir—Your correspondent, in his letter published in your issue of February 26, rather sidesteps the questions I asked regarding mining operations in Dutch Guiana.

I have no desire to enter into an argument on the merits of any special property down there, but I happen to have examined the mine he speaks of, and hope that all he says is now true, as it was nearly five years ago that I saw it and much can happen in that time. He does not mention, however, the profit derived from the 60,000 tons handled, which was an important question I asked. He might also tell me why the side-hill, shown in his picture, and into which I drove a cross-cut adit, has not been put through the mill, if everything in that picture is 'commercial' ore.

People usually go into mining with the idea of making large profits on the investment, and the point I wished to make was that no one has yet demonstrated, or proved, the existence of very attractive gold-mining propositions in that region, and until they do, investors will neglect it. I may add that I am still of this opinion, in spite of the information contained in Mr. Van Wagenen's letter.

A. P. ROGERS.

New York, March 3.

Amalgamation in Stamp-Mills

The Editor:

Sir—There seems to be a difference of opinion regarding the results obtained when the copper plates are placed in front of the mortars and when they are placed in a building at some distance from the stamps. In MacFarren's book on 'Practical Stamp-Milling and Amalgamation', published in 1910, I find the following statement (page 128): "The placing of the plates at a distance from the mortars instead of immediately following them has not been generally successful, the first reason being that it is hard to distribute the pulp evenly across the width of the plates. The gold appears to become coated with slime in the short time that elapses between its leaving the mortar and reaching the plates, so that it is rendered less readily amalgamable. During its passage the pulp to some extent loses its homogeneity, just as in a tailing-flume the coarse sand settles to the bottom. When the pulp in this condition reaches the plates, the coarser sand tends to segregate, while the finer and more dilute portion of the pulp passes on and over the plate; thus a steeper grade of plates and more water are required. The pulp flows down over the plate in a sheet

or flood rather than with a rolling over and over wave motion so desirable and amalgamation must necessarily be poor . . . With a clean ore that slimes but little and coarse gold it should be possible to amalgamate satisfactorily at a distance from the mortar, but with a sliming ore and fine gold it is doubtful. Possibly the practice at the Homestake mills at Lead, S. D., is an exception as there has been in use an auxiliary plate-house of large dimensions entirely separated from the mills in which successful amalgamation is carried on with an ore notorious for its sliming proclivities." Mr. MacFarren does not say that his opinion is based on actual experience.

On the other hand in Algernon Del Mar's book on stamp-milling, published in 1912, (p. 118) the following passage occurs: "For a small mill this system of having the amalgamating department separate from the crushing is out of the question, but for mills of large capacity there is much to be said in its favor. The usual objection is that the pulp does not distribute as well on the plates as from the lip of the mortar. This is easily overcome and in those mills where tried the saving on the plates is as good or better than where the plates are immediately in front of the mortar. There is no doubt that a millman who has to look after as many as 50 stamps and also do the amalgamating must do one or the other an injustice. If his batteries are out of order he must neglect the amalgamating or vice versa, also his hands are more or less greasy from handling the machinery, and it is almost impossible to have them clean when working on the plates." My experience has been that when the plates are in a separate room, the stamp-man is not expected to do the amalgamating, so the trouble with greasy hands did not arise. At Modderfontein B mine in the Transvaal two amalgamators were employed per shift to look after 30 plates, and in the 40-stamp mill at Waihi, New Zealand, the vanner-men dressed the plates twice per shift.

In the 'Text-Book of Rand Metallurgical Practice' I have been unable to find any expression of opinion or facts based on a comparison of the two methods. Of course, on the Rand the question is complicated by the fact that in the modern mills where the plates are placed in a separate room (generally adjoining the 'refinery') the ore is generally not amalgamated until it has been stamped, classified, and tube-milled, by which time the pulp is probably thicker than it was when it emerged from the mortars, hence the use (now discontinued) of shaking-plates.

I have also read F. L. Bosqui's paper on 'Metallurgical Practice in the Witwatersrand District' in the Transac-

tions of A. I. M. E., 1915, but, so far as I can see, he makes no comparison of results obtained by the different methods in use there. Probably this question has been discussed by the Chemical, Metallurgical and Mining Society of South Africa, but I have not now access to their publications. Possibly one of the Homestake company's metallurgists has dealt with the matter in one of their valuable contributions to the technical societies, but, if so, I have not come across it.

About 18 years ago the Waihi company remodeled the old Union or Silverton 40-stamp mill and placed the plates in a separate room at some distance from the stamps, but it is not possible to compare results obtained there with those obtained when the plates were in front of the mortars, because the ore milled then came from a different mine. The only possible comparison would be with results obtained in the same year in the same company's Victoria mill (200 stamps) crushing similar ore with plates close to mortars, but in this case the personal equation would enter, as the mills were under different superintendents and were operated, of course, by different amalgamators. Perhaps Mr. E. G. Banks could throw some light on the subject, or some of your readers may know of mills in the United States or elsewhere where both methods were tried on the same ore crushed to the same degree of fineness.

W. MOTHERWELL.

San Francisco, February 28.

Producer-Gas

The Editor:

Sir—Mr. Tait's conclusion, in your issue of February 19, regarding the use of suction-gas plants in America and Europe, derived from actual personal contact, are definite enough. But when he says that the Crossley producer (among others) made a poor showing in this country, and is not designed to operate on what we call low-grade fuels, he makes me fear for him from the wrath of that firm. Crossley's of Manchester, England, has been a leader in suction-gas power-plants for fifty years, especially in the utilization of low-grade fuels and industrial wastes, such as I enumerated in my letter of January 8. None of those low-grade fuels or wastes is used in the United States, as far as I can learn. Where is any saw-mill refuse, or rice-husks, or charcoal, or sugar-mill residue, or firewood used in a gas-producer and engine in this country? And speaking of high labor charges, if Australians can afford to pay high wages to attendants in producer-gas plants, surely Americans can do so. When I said that the net result of producer-gas installations in America had been to design a plant to use special fuels in order to reduce the labor charge, I quoted a high official in the Bureau of Mines. That plant at Tours, France, using saw-mill refuse, as described by Mr. Tait, is certainly an immense affair to produce only 500 hp. I visited the Horton ice-cream plant, on 24th street, New York, mentioned by him. It is a good type, and has operated for 10 years. Three producers burn pea-size coal, carrying over 20% ash. Drawing the gas off each is a

three-cylinder vertical engine, direct-connected to a 250-hp generator. The three generators in turn supply current to slow speed motors driving three refrigerating machines, and accessories. It will be seen that each producer, engine, generator, motor, and ice-machine is a complete unit. The management is completely satisfied, and said that power was being produced much below the price quoted by the New York Edison Co. for electric power, also that if an extension were made, additional gas engines would be put in. Coal consumption is around three pounds per kilowatt. Incidentally, they make up to 100,000 quarts of ice-cream daily in the hot weather.

While Mr. Tait is generally not favorable to the suction-gas power-plant, I find in a recent issue of 'The Scientific American' an engineer advocating its further use. In a table showing central-station power in the United States, 'Power' of February 8 states that only 18,316 hp. is generated by producer-gas engines, this being under 10% of the total of internal-combustion installations for suction-gas engines came under that head. It seems to me that there is some prejudice in this country against the producer-gas power-plant, and I hope that the day is not far distant when, where low-grade fuels and wastes are easily obtainable, and power is required, such plants will be operated. It is to be hoped that the feeling about European and American practice is not like Boston and New York over subway car-doors and voting-machines. It was said that because subway cars with side-doors operated well in New York it didn't follow that they would do so in Boston; and because voting-machines were satisfactory in Boston they wouldn't do in New York; or something to that effect.

New York, March 1. M. W. VON BERNEWITZ.

The Rod-Mill

The Editor:

Sir—In your issue of December 4, under the above caption, I note the performance of a rod-mill that requires two horse-power to operate and crushes from two to three tons of ore per hour through a 40-mesh screen from a crusher set at $\frac{3}{8}$ inch. As this is an extraordinary performance, a little more information as to the kind of ore and a screen-analysis of the crusher product would be of interest; also whether this output has been sustained after the mill had been in use some time.

In an entirely different department of milling I can match this seeming impossibility by stating that in our flotation mill, where crude oil is added to the ball-mill pulp and pine-oil in the flotation machine, we are amalgamating on copper plates both after the classifier before flotation and after the flotation machines. The flotation oils do not foul the plates and although the ore contains sulphides the plates are as bright and free from contamination as any I have seen in the usual amalgamating mill. This no doubt is news to many of your readers, who have imagined that flotation was inimical to amalgamation.

ALGERNON DEL MAR.

Nayarit, Mexico, February 10.

Valuing Partly Exhausted Mines—I

Examining Closed Mines Either Caved or Flooded

By Morton Webber

Valuing a mine from which most of the exposed ore has been removed, but where there may remain important future possibilities under intelligent development, is one of the most difficult problems in mine appraisal. Unless there is collateral evidence from neighboring operations, the exhausted portions of the deposit are the only index to the possibilities of the future. If the mine is closed down, the problem is even more hazardous.

The examination of idle mines and the examination of partly exhausted mines in operation will be discussed in two articles under the above title. The second article will refer to valuing mines that have been gutted by intensive production, but where excellent possibilities may exist if intelligent development is resumed.

In the case of mine-workings that are largely inaccessible, the engineer is forced to turn to stories of the past for information as to the possibilities of the future. Records of production have to be compared with the extent of the areas from which the ore came. In an important number of cases the ore that was marketed, either by means of local treatment or by shipment, represents only a portion of the rock mined. Costly mistakes have been made by assuming that stoped areas, as shown on old maps, furnished an output equal in head assay to the gross yield of the ore. This mistake means that the valuing engineer, on re-opening the property, will expect a much larger mine than will be found; also new orebodies so discovered, when subjected to sampling on the basis of a milling width, will prove lower in grade than indicated by old records.

When mines are caved or flooded, it is impossible to investigate old stopes. Comparison of their size with the mill-tonnage is impossible. I have found it valuable to remember, when the examination is based so much on inference and retrospection from effects to causes, that, assuming the deposit is not exhausted, a large mill-dump is a good sign, and a large mine-dump may be a bad one. People in their senses do not mill large tonnages at a loss. If the available record of stope-production compares in tonnage with that of the mill-dump, a definite estimate can be made of the gross stoping-value of the ore. The size of the mill-dump therefore furnishes a rough yard-stick for the past size of the enterprise. If fairly reliable plans showing the depth and length of the workings are obtainable an approximate horizontal foot-ton calculation can be made.*

Old records of mill-yield alone may be most misleading if unaccompanied by data evidencing the extent of underground operations, because the calculation may be vitiated by sorting or selective mining. The best evidence of the latter is a large mine-dump. In the case of the examination of a closed and partly caved mine possessing a large dump, the existing plans should be carefully consulted. Unless considerable shaft-sinking or cross-cutting has been done in dead ground, where ore could not be expected, a large dump can only mean one of three things: that the orebodies were narrow or spotty, or that they were recurring at wide intervals with intervening areas of barren ground, entailing expensive development, or that the former management did not understand the deposit and was unnecessarily often off the ore. The last phase I never assume in the absence of very cogent reasons.

In the case of base-metal mines the metal prices over the period of past production should be compared with the price to be expected in the future. Prognostication of the average price of a base metal is difficult. As a basis for the future, I consider that a mine should be able to earn 7% on the cash investment, when the price of the metal is a split between the average of the last 15 years and the average of the low price for each year for 15 years. On such a basis, given normal metal prices, the mine should make a profit commensurate with a mining risk and it will be in a position to weather most vicissitudes of the metal market.

The re-opening of an idle mine is usually a rank gamble, with the odds against the maker of the bet. Large profits may, however, be made in this form of exploration. It has the attraction that the measure of the production of the past indicates what may be expected in the future, assuming successful exploration. In this way it differs from the 'prospect', where the future size of the enterprise, irrespective of the success of development, is usually indeterminate.

This class of examination obviously presents great difficulty in getting at the facts. All sorts of reasons are

on its lowest level of 400 ft. by 7 ft. wide is exposing 200 tons for every horizontal foot, assuming 14 cu. ft. to the ton. The term is valuable as a rough gauge of the size of the enterprise; for example, a 100-ton mill would exhaust a 100-ft. 'lift' every 200 milling days. This assumes the prolongation of the deposit in depth on this basis. The calculation is invaluable in estimating how far a mine must continue below the lowest level in order to return a fixed sum of money.

*For the aid of junior readers it may be well to explain the term 'horizontal foot-ton'. A mine with a length of ore

presented by local inhabitants to lure the proposed purchaser. New enterprise means local business. Some of the stories are plausible, some are ingeniously seductive, and some are absurd. In getting at the facts the engineer must endeavor to emulate Sherlock Holmes. In the absence of an actual example, direct suggestions are impracticable.

The usual stories giving a reason for closing a profitable mine are quarrels between the former owners, which led to litigation. While, no doubt, there are bona-fide cases, my experience is that such quarrels, in the great majority of cases, indirectly were caused by a disappointing mine. It is human nature to prefer fair weather sailing. The history of profitable mines is that they have been unusually free from internal disagreement. My experience of actual cases is that internal dissension was generally associated with mines that had 'broken' three or four owners, or that not uncommon type of mining enterprise which financially is always running on the 'ragged edge'. The latter class incites each owner to believe that he can do better than the other. The psychology of being always pinched finally leads to a row. If the mine had been a profitable operation, while the owners may not have been always accordant, the presumption is that normal people would not let a disagreement go far enough to close a profitable mine and destroy an organization.

Another story often offered is that a clique among the owners closed the mine to 'freeze' weaker members out. This story is generally false. Another reason is that owing to deaths the property changed hands and was tied up under probate. This is credible, but the presumption, as in the other cases, is that heirs to a title under probate will go a long way to keep a good mine open, and so prevent caving or flooding with water.

The foregoing examples illustrate the most usual causes presented by vendors; they should be regarded with suspicion. Bona-fide cases exist, but the presumption is against the venture. It is like a man going into court with unclean hands. On the shoulders of the vendor should rest the onus of proof that a closed-down mine has merit.

I will now deal with the more reasonable causes for closing down mines worthy of being re-opened. I have found them to be either revolutions or other forms of governmental or fiscal change, subnormal metal prices, or fundamental changes in marketing conditions. Many good properties in Mexico, under development or at the production stage, have been forced to close down during the last ten years. No doubt the sands of time, like distance, will lend enchantment to their prospects. Nevertheless, there is money to be made in re-opening meritorious properties. The engineer should, however, be careful not to get some old derelict foisted upon him that was closed, and in bad repute, prior to the deposition of President Diaz. Similar opportunities for exploration should exist in Russia when that unhappy country returns to normality.

The fall in metal prices is a real cause for closing

down mines that under normal metal prices and modern metallurgical and marketing facilities should yield a profit. The price of most of the base metals can be obtained for the last thirty years. If the examining engineer can definitely ascertain the year the mine was closed down he can readily tell if this was a probable cause.

There have been numerous cases where in former days a good mine could not make a profit owing to inaccessibility, until a railroad completely changed the whole financial aspect. Such mines had their 'eyes picked out', the only portions of the deposit that could stand freight and treatment having been removed. This meant that the lower-grade orebodies were developed by the former owners at their expense, and in many cases these workings can, to a considerable extent, be used by the proposed optionee. An adjacent railroad, together with modern metallurgical and mining methods, may make these upper workings profitable. The development of new ore-bearing ground in depth should be even more profitable. The high-grade portions, which the former operators mined, should be found by deeper development.

The above represents the most hopeful opportunity in re-opening old mines. For example, in the State of Sinaloa, Mexico, old silver mines exist that were operated in days when the only means of marketing was by packing the ore on mule-back to Culiacan, whence it was transported by ship. The West Coast railroad permitted a radical reduction in mining and metallurgical costs, and important mining enterprises were getting under way when Madero, with his disconnected visionary ideas, involving mis-government and industrial decay, threw the republic back a decade.

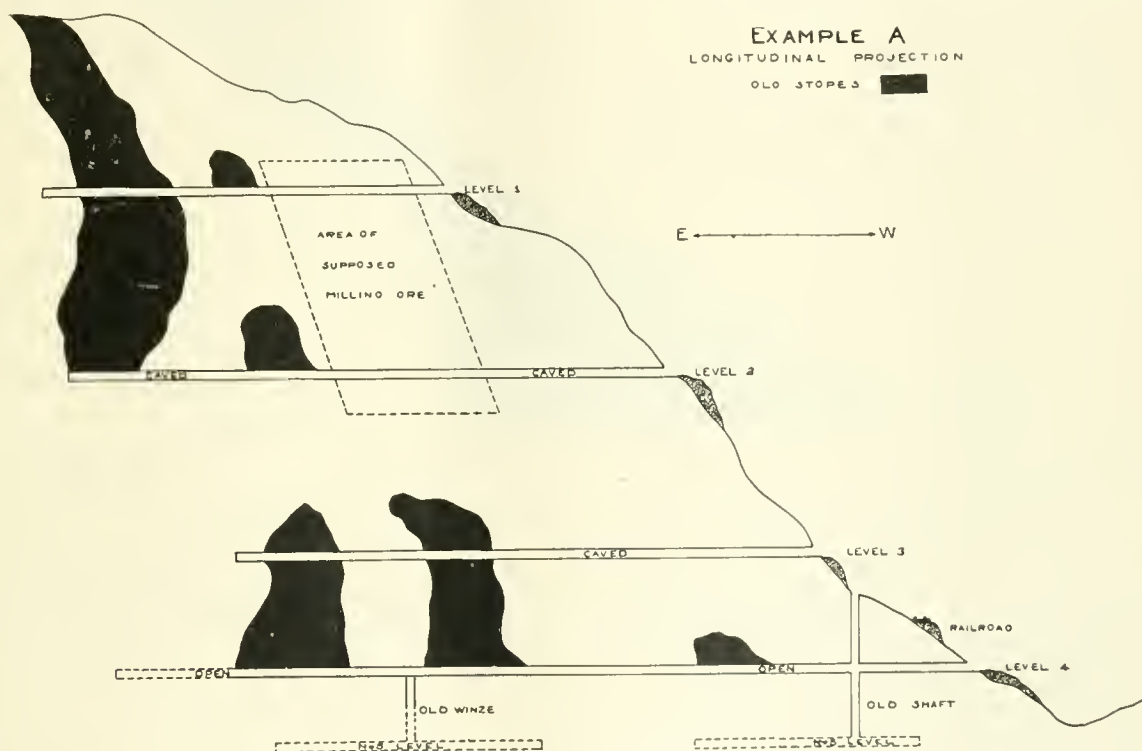
The engineering sources of loss in re-opening closed mines is another phase of the subject. It is a difficult one, for there is little than can be dealt with in a tangible way. Technology is subordinate to latent shrewdness in sifting facts from the mist and shadows of the past. The experience of the engineer will enable him to eliminate much of the chaff, because many of the stories will collapse under the searchlight of engineering common sense. The prime faculty required, however, is the basal requisite of the valuing engineer; balanced optimism.

The most common source of loss is in spending too much money in re-opening old upper workings when better considered exploration would have suggested (apart from whether future possibilities were existing or not) that only indeterminate results could be expected. Also more money has been spent on unsuccessful ventures than necessary because those who undertook the project did not know when to stop. Both of these errors are attributable to poor engineering in laying out the work. Such a program should have as its main object, on the smallest expenditure of money, to demonstrate whether or not the proposition has merit. If the possibilities of the venture are properly understood before commencing work it should be possible to divide the proposed development into three phases, the first phase being a pro-

gram in terms of development feet that will allow the engineer in charge of the work intelligently to turn down the venture. Should the enterprise emerge from the first risk successfully it will change in character from a gamble to a less hazardous operation. In other words, an engineer reporting on such a project should endeavor to advise his client that a fixed sum will open up the property to a point where he can advise the further expenditure of a fixed sum of money on the basis of speculative development. On the completion of the second budget the property will have emerged from the prospect class to that of a mine with only the inherent mine-risk.

The great mistake in this form of mining speculation is that the splitting up of the work into these phases is

posed development of a mine into three classes of risk, I submit two longitudinal projections of actual examples. Both mines were closed down. Example A, a lead-silver mine, was badly caved on levels No. 1, 2, and 3. Old maps showed the various stopes from which shipping ore was removed. The orebodies were of the recurring type contained in a true-fissure vein in granite. The dotted lines represent a definite initial-risk program well considered and laid out in advance. There was a difference of opinion as to the advisability of opening up level No. 2. Local information indicated that a large body of medium-grade ore was exposed by this level that could not be mined by the former operators, but was expected to be profitable by virtue of a later railroad shown on



frequently overlooked. The initial risk, getting to a point where the engineer can intelligently advise stopping or carrying on, the latter being the intermediate risk, and the third stage (the ordinary latent mine-risk) are garbled or their relation ignored. By failure to segregate these classes of risk, much money has been wasted. It takes strength of character, that peculiar phase of executive ability, the power to say No, to recommend the cessation of operations. There is always the desire to go a bit farther. When this is done, the longing is still there, and those financing the undertaking are again approached, with the result that in the end, although every person may have been sincere and honorable, those financing the project withdraw their support and an atmosphere of general unpleasantness is left. Had, however, the development been intelligently laid out at the inception, everyone connected with the enterprise could have 'read as he ran', and at the conclusion of the initial-risk program, if it was advisable to 'cut the loss', only first-class fair-weather sailors would squeal.

To clearly illustrate what I mean by dividing the pro-

posed development of a mine into three classes of risk, I submit two longitudinal projections of actual examples. Both mines were closed down. Example A, a lead-silver mine, was badly caved on levels No. 1, 2, and 3. Old maps showed the various stopes from which shipping ore was removed. The orebodies were of the recurring type contained in a true-fissure vein in granite. The dotted lines represent a definite initial-risk program well considered and laid out in advance. There was a difference of opinion as to the advisability of opening up level No. 2. Local information indicated that a large body of medium-grade ore was exposed by this level that could not be mined by the former operators, but was expected to be profitable by virtue of a later railroad shown on the map. I was against this work as being indeterminate; because, assuming ore was found, it would be limited in area by the surface, other old stopes to the east, and by the accessible No. 4 level. My opinion was that ore, if existing, would be of no value to an optionee unless the future of the property was assured by the vital development of No. 5 level and the easterly extension of No. 4 level. As an alternative, I advised that if the money allocated to this level was to be spent, it could be utilized to better advantage by further extension of No. 4 level than indicated by the dotted line; the agreed initial-risk program on this level. However, I was in favor of confining the initial-risk program to the work indicated by the dotted levels. My connection with the enterprise was only as a consultant and I was overruled.

The initial-risk program disclosed smaller orebodies, and less of them, than had been found above. These data indicated that should another two levels be installed they would not pay for their expense and the lower of them would prove to be coincident with the bottom of the deposit. The opening of No. 2 level proved disappointing

and expensive, as running ground was encountered, and, as I contended, it afforded only indeterminate results.

If the initial risk program had been encouraging, the main shaft could have been extended another couple of lifts and two new levels driven. This development would be the second risk. It would have constituted an attractive development speculation in relation to the initial risk, which was obviously a gamble. Had the second-risk exploration been favorable a third-risk program could have been undertaken. At the commencement of the third phase the property would justify the dignity of being called a 'mine', and the development thereof as a normal risk. The third-stage program could be simultaneous with the erection of a treatment plant, so that their completion would be coincident.

Example B introduces other features of interest. Like example A, it is a vein deposit, but instead of being a mine composed of recurring ore-shoots it was of the single-shoot type. The deposit had been worked down to the 800-ft. level, when it was closed by a cycle of silver depression. The metallurgical treatment was table concentration. The subsequent rise of silver to about double the price at the time when the mine closed, extensive flotation experiments that indicated an extraction far exceeding former operations, and a recent power-line in contrast to wood fuel, led to an option to re-open the mine. The initial-risk program consisted of renovating shaft B, which was in fair condition, and sinking another lift to point K for the 900-ft. level. Before sinking was commenced the 800-ft. level was re-opened and the floor sampled. At this stage the gamble looked attractive, for, among other features, the ore-shoot seemed longer than on any level above. The information of the 900-ft. level was then not known. This should be understood to appreciate the situation as of that time. There was nothing to show that the pitch of the ore-shoot was flattening and that the increased length of the level was due to the fact that the plane of the level was approaching the major axis of the shoot. All the levels above the 800-ft. level were caved.

The 900-ft. level was disappointing in the length of the ore-shoot and also in its grade. A consultation ensued and different views were expressed. My recommendation was to reject the business. Another engineer (who was also an underwriter) disagreed logically. He advised that considerable money had been spent in re-opening the shaft and installing sinking equipment, that the shoot had narrowed once before at A B, and that, all things considered, it would be better to sink another lift.

At this stage luckily the matter was taken out of our hands by the owners. The option under which we were working was unfitted for a development of this kind. The price was reasonable but the payments came too soon. They were not in alignment with engineering requirements—a prime essential of an option on a development proposition. My clients, as the result of the somewhat disappointing evidence of the 900-ft. level, asked that the next maturing payment and the succeeding payment be post-dated to the date of the third payment. This

was refused, and the option was dropped. The owners no doubt felt that as the optionee was in a sense committed they could force proceeding on the basis of the option. They probably desired to get some of the purchase money whether the mine made good or not.

Eventually the owners made a deal on a less favorable basis with others, the result being that the shaft was sunk another lift and a new 1000-ft. level was driven. This development showed the radical flattening of the shoot and its probable termination in another lift. The information gained from this example is that while there are exceptions, in the great majority of cases unless the results of the initial-risk program come up to expectations the loss should be cut promptly. An exploration company following this practice will save large sums of money, although there is always the unlikely chance they may lose a mine. In the case presented, if the owners had not taken the mine out of the engineers' hands the second-risk stage would have been entered upon, which was intended to be two new levels below 900 ft. The results of the 1000-ft. level would, however, have been so disappointing that the work would have terminated.

In concluding this article on the examination of idle mines, I shall endeavor to summarize the foregoing discussion in precise form. This is difficult, for the subject is not adapted to direct presentation. It is gambling on the accuracy of retrospective reasoning. It is introspective, for the engineer should use his experience to dissect the plausibility of the reasons for shutting down a meritorious mine by what he would have recommended, or have been forced to do, under similar circumstances.

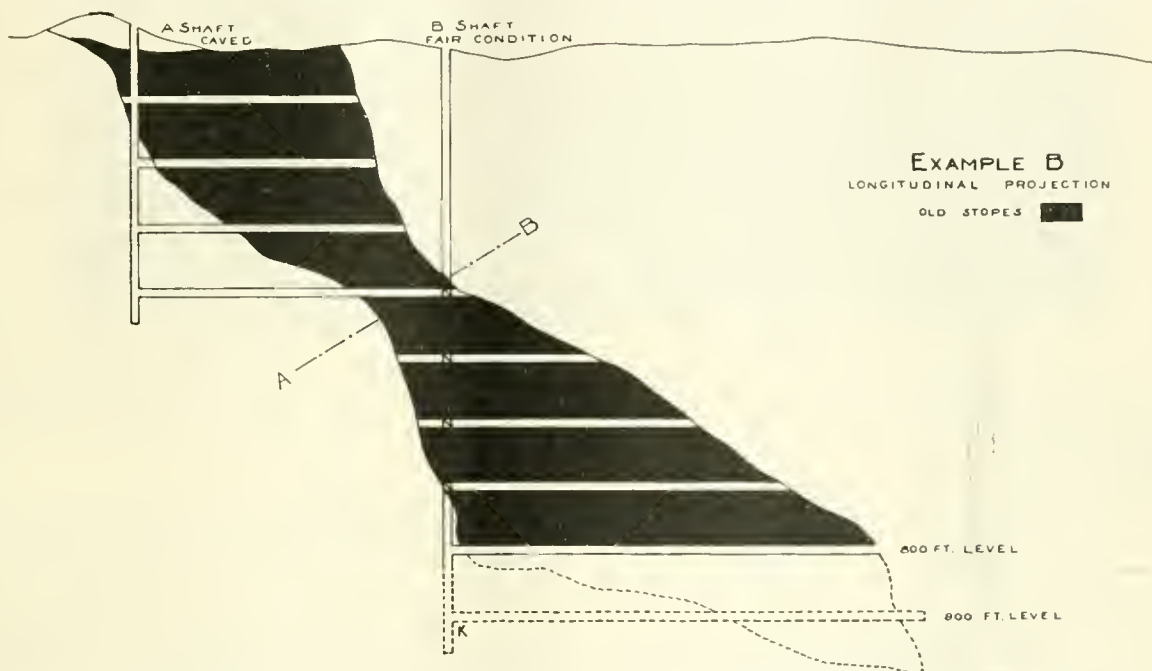
A closed mine must pass through three stages before it again resumes profitable operation. The opening up of the property to test the truth of the evidence of the past is a gamble. I call this the initial risk. Should this prove encouraging the property will then emerge on a lesser degree of risk, namely, that of an attractive development speculation. In the event of the enterprise emerging successfully from the second phase, it will then become a mining risk. While the demarkation or dividing line between these three phases of risk is not obvious, theoretically it exists; therefore, I have endeavored to divide such a development into three financial budgets: the first being the gamble or 'ante' to see if there be a justification for proceeding further. The second budget is to provide for legitimate exploration, the risk of developing an attractive project with the possibility of total loss of the investment in the hope of making a large gain. The third stage is that of equipment pre-supposing a finite minimum life. The third stage is obviously a normal risk.

If old maps of workings are obtainable, their intelligent study should indicate the pitch of the ore. If the mine is going to make good, it should be possible to lay out an initial-risk program by a level right in line of the pitch, as in example B. If such a level does not disclose ore it is difficult to see where else the mine can make good. The same argument will apply to example A. If the initial-risk program is not definitely encouraging, a loss:

should be cut. If it is partly encouraging an independent examination is advisable. Engineers are human and the most honorable may fall victim to the wish being father to the thought. The main thing is to avoid following a loss—throwing good money after bad. The re-opening of old upper workings in the great majority of cases should be avoided. The money should be spent in the extremity of the deposit where ore must exist if the mine has a future. The property should be 'made' or 'broken' there; it is there that the work should be centralized. The expense of opening up old portions of a mine in the

a depth of 40 or 50 ft. The ore from the Cordoba mine has been averaging from 65 to 68% of manganese dioxide and 4% of iron oxide. Various samples from the newly acquired mine at Ojo de Agua, Santiago del Estero, show 75% of manganese di-oxide and only one-half of 1% of oxide of iron.

A small surface-deposit, discovered some years ago in the province of San Luis, about 250 miles to the south, is thought to be another appearance of this same seam. During October 1920 manganese was discovered in the territory of Los Andes, but, due to the isolation and lack



search for ore that must be limited in extent, as evidenced by surrounding stoped areas, as in example A, should be delayed till the future of the mine is established; and the optionee knows that he wants the property.

Manganese Mining in Argentina

There are two operating manganese mines in Argentina, states a consular report, one of which has been worked on a small scale for over two years. An increase in the local demand for manganese in the glass and iron industries has recently caused an increase in the activity at this mine, and the operating company has now acquired the rights of the second mine.

Both of these mines are in the heart of the Santiago desert country, one in the province of Cordoba, 75 miles north of Dean Funes, and the other 25 miles farther north, near Ojo de Agua, in the province of Santiago del Estero. The manganese occurs as di-oxide in a single rift in the granite. This partition of the granite hills is known to extend for at least 50 miles, disappearing at times with the disappearance of the strata. Although the seam has been opened at no less than 50 places, the two mines mentioned have shown the best prospects of good returns. The greatest width of the seam is at Ojo de Agua, where in one spot it reaches 8 ft. The average width is from 3 to 5 ft., narrowing to almost nothing at

of transportation facilities, nothing is yet known of the quantities available.

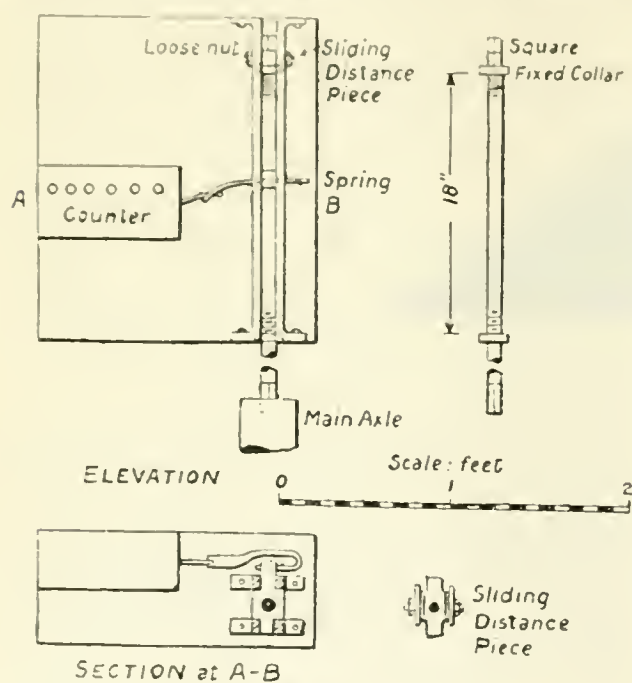
The Santiago mines are controlled by an Anglo-Argentine contracting company, which works the mines on its own account and operates its own mill in Buenos Aires. The product is sold to two foundries and two glass factories in the city. During the operation of one mine for 30 months, 6000 tons of sorted and graded manganese ore was delivered in Buenos Aires, an amount sufficient for local needs. The mine at Ojo de Agua in 10 months of operation yielded approximately 1400 tons, of which only 400 tons was sent to Buenos Aires. Both mines were worked by native labor, which has been so cheap—from 60 centavos to 120 centavos (\$0.24 to \$0.48) per day of eight hours—that no attempt has been made to install even the simplest handling machinery.

The greatest expense is incurred in hauling the ore from the mine to the railway. Transportation is accomplished by means of the native two-wheeled 'chata' drawn by eight horses and carrying 1½ tons of ore.

With the acquisition of the new mine and the present prospect for an increased demand for manganese for local consumption and for export, the Argentine mining company is making arrangements to increase its production and to improve the transportation conditions. It is expected that the two mines will soon produce 600 tons of graded ore per month.

Automatic Mine-Car Recorder

A recorder, to register the number of cars trimmed from a mine, is described in a recent bulletin of the Institution of Mining and Metallurgy by John J. Freund. In the case in question the workings were situated on a range of hills which rose abruptly about 1000 to 1200 ft. above the adjoining plains. The deposits were situated on the plateau at the top of the hill range and also on the brow of the hill, extending about 200 to 300 ft. below the crest. A main haulage level ran along the hill slopes about 350 ft. below the crest, and this was fed by various inclined tramways which rose above the main haulage level and served the various workings. From the main haulage level the ore was lowered to the foot of the hill range by a self-acting 'va-et-vient' incline about 2200 ft. long, which rose 812 ft. vertically. The coolies were paid on output, which was measured by the tram-wagon full,



DETAILS OF MINE-CAR RECORDER

but owing to the untrustworthiness of the native staff the want of some automatic check on the counting was desirable.

The arrangement finally evolved was as follows: Into the centre of the main axle of the inclined gear a square hole about 1 in. deep and $\frac{3}{4}$ by $\frac{3}{4}$ in. was made, and into this the squared end of a 1-in. round-iron rod was placed. This rod was threaded and revolved with the main axle, first in one direction, and then, with the next trip made, in the other direction. On the threaded portion of the 1-in. rod (in this case about 18 in. long) was placed a nut with shoulders. The shoulders moved in grooves to prevent the nut from revolving, and so caused it to travel up and down the rod. Each revolution of the main axle meant that the trams on the incline traveled $20\frac{1}{2}$ ft., so that about 107 revolutions were required to make a complete journey. The screw threads on the 1-in. rod were

Whitworth, 8 per inch, so that the nut moved about 134 in. per trip. Attached horizontally to the nut was a spring.

The counter used was of the ordinary type. The rectangular box may have been 10 by 5 by 4 in., and the small lever projected 2 or 3 in. A spring fixed to the nut came in contact with the lever on the counter and moved it alternately up and down for every trip made on the incline. The mechanism was enclosed in an iron box, like a small safe. Owing to a certain amount of slip between the hauling rope and the main wheel, the position of the nut, which moved up and down the 1-in. rod, required adjusting once a week. This was effected by lifting the rod out of the square hole in the top of the main axle and turning the rod around until the nut was in the desired position, when the rod was again dropped into the top of the axle and the box closed. A projecting piece of iron fixed to the door was then passed over a collar on the rod, making it impossible to lift the rod and revolve it independently of the main axle.

The arrangement worked satisfactorily. Neither the sketches nor the description profess accuracy. Both are from memory and are only given to indicate the general idea. The entire mechanism, excepting the counter, was made by a native blacksmith having only the usual hand tools.

THE Bluefields district of Nicaragua comprises an estimated area of 35,000 square miles and is bounded by Honduras on the north, the Caribbean sea on the east, the San Juan river on the south, and extends on the west as far as the Continental Divide, states a consular report. Its topography is, in general, low and swampy on the coast, gradually rising to an elevation of perhaps 3000 ft. in the western part. Low mountains extend almost to the coast in some places. The many rivers rise in the mountains and follow an easterly course to the Caribbean sea. The soil varies from sandy on the coast to a red clay, in most places covered by silt deposited by the annual floods; but in many places in the higher lands the soil is a volcanic ash. The climate has two seasons, a wet and a dry, which are much more clearly defined as one approaches the Pacific. The wet season on the coast lasts from June to January, the annual precipitation probably amounting to 140 in. The thermometer ranges from 60° to 95°F. Gold mining has been carried on for years; and, with the return of the gold dollar to something like its former purchasing power, it is believed that considerable activity will take place in this industry. American investments in mining at this time are not far from \$5,000,000, and the British must have about \$2,000,000 invested. The district has many latent possibilities: friendly people, with a wide knowledge of English, wonderful natural resources, accessibility to United States and European markets, a climate, excepting malaria, not at all bad. The only reason for lack of development is deficient transportation facilities—no roads, no railroads, and but one harbor which is useless for vessels drawing more than 12 ft. of water.



THE VALLEY OF THE BODAIBO, IN SIBERIA

Russian Placer Mining

By L. A. Perret

INTRODUCTION. The mineral wealth of Siberia and the Ural has long since attracted the attention of the financial centres of the world, especially in respect to gold. English, French, and German operators, among whom the English took the lead, repeatedly attempted to make a lucrative use of their capital in precious-metal mining; but in spite of heavy expenditure most of the ventures have proved failures. In view of these facts I think it pertinent to comment on the fate of the numerous foreign enterprises, as well as to describe the conditions under which foreign gold mining has been conducted in Russia.

THE GERMANS. German capital was used in Russian gold-mining enterprise in 1898, when a concern financed by the Deutsche Bank prospected in the Niman gold-field of the Amur province in Eastern Siberia. After spending about 300,000 rubles it suspended operations, having achieved nothing.

THE FRENCH. A Paris concern has been prospecting a concession on the western border of the former Cabinet lands for the past three years, but has now stopped work. The French hitherto have confined their activities to the Ural, where, during several decades, up to the time of the Bolshevik regime, a gold vein had been worked in the Katchkar district, in the government of Orenburg; and extensive platinum placers were exploited at a considerable profit in the Goroblagodatsk (along the river Iss) and Tagil districts. In the northern Ural, a French

metallurgical company located a large number of gold placer claims, but it is now extinct.

THE ENGLISH. Of all the foreigners engaged in Russian and Siberian gold-mining undertakings, the English have contributed by far the largest amount of capital. The first attempt in Siberian placer mining was made, I believe, in 1889 by an English trading company, which brought goods by steamer to the mouth of the Yenisei river and sent engineers to investigate the North Yenisei placers. After this, nothing was heard of English capital in Russian gold mining until the beginning of this century; but between then and 1916, according to the records of the Russian-English Chamber of Commerce in Petrograd, £8,800,000 was invested, distributed among 25 companies scattered over the gold-producing districts of the Ural and Siberia. With two exceptions, the operations of all these companies resulted in entire failure. Rusting mining and dredging machinery, abandoned geodetic instruments, gold-weighing scales, and even traveling requisites left in the possession of Russian employees are, in many instances, the only remains of past activity. All these British concerns were American from the technical point of view, inasmuch as they employed, as a rule, American engineers who were supposed to be specialists in placer mining. The properties were well equipped with English and American machinery; the companies were amply supplied with funds; they were welcomed by the Russian government, which often gave

them facilities not accorded to its own people. Notwithstanding such favorable conditions, the result, on the whole, was dismal, except in two cases: (1) the Lena Goldfields, which has been merely a shareholder in the Russian Lenskoie company, and entirely under Russian management and Russian technical direction; and (2) the Orsk Goldfields, the operations of which on the Kolchan placers, in the maritime province of Eastern Siberia, yielded no profit during the first nine years, regardless of the fact that American mechanical methods were adopted. Only for the two years immediately preceding the Bolshevik revolution did the Kolchan mines succeed in paying dividends.

One can but wonder that, after such disastrous experiences, some engineers, especially American, should assume the exclusive knowledge of how to work Russian placer mines, and should claim the credit for all the improvements made and prospective. It is not my intention to pretend to teach my foreign colleagues in any way, as I have the highest esteem for their splendid work in Russia and Siberia in other branches of the mining industry; but as regards placer mining, the great number of failures gives cause for reflection. During the past thirty years I have had ample opportunity to watch how placer-mining operations in all the important gold and platinum districts of the Russian empire were started and carried on by foreign concerns; and I consider myself qualified to enumerate the factors that led to the failure of these Anglo-American enterprises, of which the following are worthy of attention:

A. IGNORANCE OF THE RUSSIAN LANGUAGE. Foreign mining men, especially from America, expect the local employees to perform the work in the American way, and with American tools; and rely upon interpreters for the conveyance of the necessary instructions. These interpreters are seldom technical men, and in most cases know practically nothing about placer mining. The result is that in spite of the remarkable faculty of the Russian, especially the Siberian miner, to catch an idea even if conveyed to him by gestures, and in spite of his inherent willingness to do as he is ordered, he is not able to understand what is wanted, and therefore proceeds with hesitation, which is inconsistent with efficiency. The foreign employer then complains of the Russian laborer's laziness, low efficiency, prejudice, cunning, and ignorant suspicion. On the other hand, when a Russian explains something to his foreign employer, the latter often misunderstands him. In the English technical press and in English technical literature one finds the most absurd opinions, which evidently arose from the misunderstanding of statements made by Russian mining men. The lack of knowledge of the language is also the reason why Americans working in Siberia do not trouble to acquaint themselves with the Russian mining law, though a knowledge of this must be considered as an essential qualification.

B. IGNORANCE OF LOCAL CONDITIONS. These, both climatically and economically, are very different from those prevailing in America and other gold-producing coun-

tries, even Alaska, and exercise a predominant influence on working methods, transport facilities, and labor questions. Although, according to J. P. Hutchins,* the system of transportation to remote gold districts seems far better organized in Siberia than in Alaska, nevertheless the conveyance of heavy machinery to some of the Siberian goldfields is impracticable under existing facilities, or can only be achieved at a cost that is financially prohibitive. For example, the transportation from Irkutsk to the Bodaiho mines, a distance of 1000 miles, of a 17-ft. bucket Bucyrus dredge, ordered by the Lenskoie company, according to a careful estimate based on wages and prices current in 1917, is figured at 3½ million rubles. There is the freight from Milwaukee to Irkutsk; the storage, because the entire equipment could not be transported in one summer without stoppage, and parts of it must therefore be left during the winter at some place on the way; and the interest on the expenditure for the total time required. Transportation alone will therefore amount to between four and five million gold rubles. The Lenskoie company can afford to try such an experiment, being in an exceptionally favorable condition, and having enjoyed many decades of highly profitable operation, as a result of the extraordinary richness and extent of the gold-bearing channels of that district; but I believe that there will not be many placer companies in America, to say nothing about Russia, where capital is scarce, disposed to risk such an expenditure at the start. Think of the cost of transporting two or three dredges of that size to an isolated district in Russia!

C. DISREGARD OF RUSSIAN MINING METHODS. By far the most important reason for the failure of foreign enterprise is the disdain of Russian methods, with which foreign engineers deem it superfluous to become acquainted. This is a great error. In every branch of human industry there are certain methods of doing things that owe their *raison d'être* to the elaborate and careful study, by several generations, of the peculiar local conditions to which those engaged in a particular task must adapt themselves if success is to be achieved. By mistakes, and their subsequent correction, nations have succeeded in working out the fundamental principles to which the different branches of industry ought to be adapted. This is the substance of experience; and if experience is important for the success of the individual, it is more important for the industrial life of a whole nation. It is the task of the enlightened engineer to apply the improvements he wishes or considers indispensable to the fundamental principles on which local methods are based. To disregard such long-established principles is stupid.

Placer mining has always been an important branch of the Russian mining industry. It has produced about 90% of the gold output of the Russian empire, which until the 'eighties of the past century held the lead among the world's gold-producing countries. It is ab-

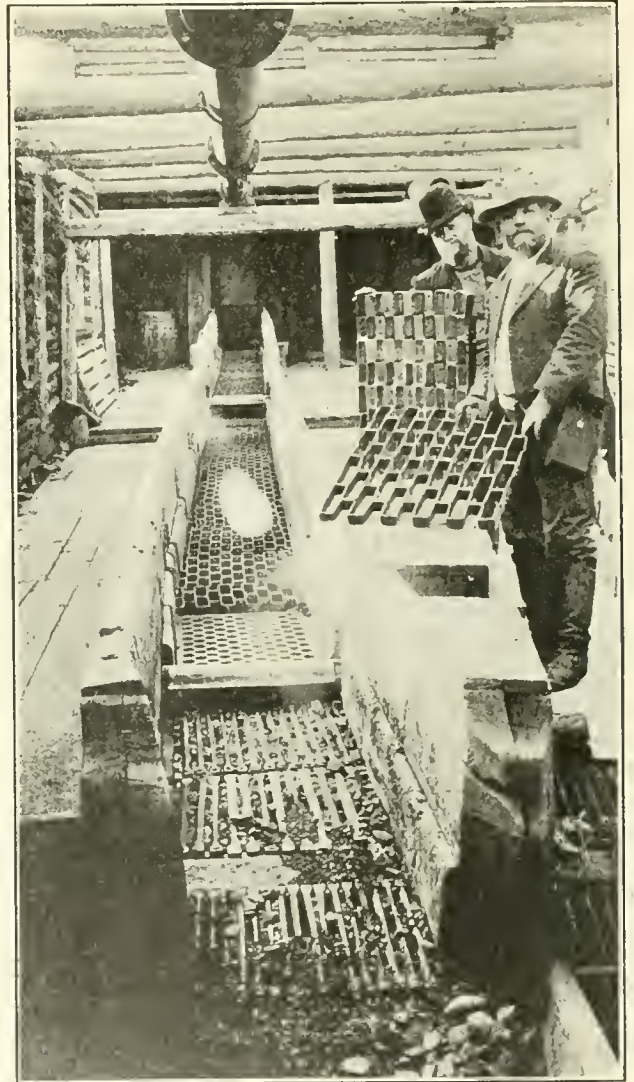
*E. & M. J., May 11, 1918, 'Drift Gravel Mining in Eastern Siberia'.

surd to think that a progressive and intelligent nation, which has been engaged during more than 100 years in exploitation on a large scale, should not have discovered the fundamental principles best adapted for local conditions. Technical application may always be open to further improvement, but the principles themselves, as axioms, must stand. This is particularly the case with regard to placer mining, in which local conditions play a more important part than in any other branch of mining. But this is what many American and British engineers coming to Siberia do not admit, the result being the publication of articles such as, for example, the one in the 'Engineering & Mining Journal', of May 11, 1918, by J. P. Hutchins, and in the 'Mining and Scientific Press' of September 6, 1919, by C. W. Purington.

The article by Mr. Hutchins deals in detail with Russian mining methods, labor, and operating conditions. An analysis of the statements made will prove the falsity of the impressions they convey. Mr. Purington's article, so far as concerns mining operations on the Lenskoie Gold Mining Co.'s placer mines, is incorrect, in that it gives credit to Reuben E. Smith for all the improvements lately introduced; whereas, except in connection with the introduction of the Alaskan sluice (which, as will be shown, is not an improvement) all have been made exclusively on Russian initiative by Russian engineers, who commenced work many months previous to the first arrival of Mr. Purington and Mr. Smith. The Russian engineers introduced a new system of drifting by a long-pillar method, underground tramping, inclined shafts with endless-rope haulage, recovery of mine timber (which resulted in an economy of 60% of all the timber used), new washing plants of great capacity with mechanical elevators for the tailings; winter washing of the gravel coming directly from the shafts as drifted; and many minor modifications, such as the construction of improved trucks. All these changes were modeled on the practice already in use for many years at the Schouvaloff platinum placer mines, in the Ural. Mr. Purington is aware of the fact that the improvements were started in February 1913, and were gradually introduced on all the properties. This was no easy step, as the mines had to be worked intensively to make up for the losses incurred by the Lenskoie company in consequence of the strike of 1912. Mr. Smith, who originally came to Siberia for another concern in the capacity of expert drill-master, but without previous experience in Siberian placer operations, entered the service of the Lenskoie company in September or October 1913, and in the beginning worked exclusively for Mr. Purington, who was preparing a report for the directors of the Lena Gold-fields. Up to the end of the operations in 1914, Mr. Smith held a position that did not enable him to work independently on would-be improvements, except in connection with the erection of the Alaskan sluice. Mr. Purington's statement that "up to 1914, the methods of drifting used by the Lenskoie Gold Mining Co. were of archaic description" does not correspond with the facts.

Among the improvements mentioned, the recovery of

timber underground deserves special mention. It was originally applied at the Schouralinsky placers (in the Verkhisetski district, in the Ural) where the overburden, consisting of soft plastic clay mixed with fine gravel, was particularly favorable, inasmuch as it settled easily and uniformly. I wished to introduce this system on the Schouvaloff mines, with some alterations in accord with the different nature of the ground (overburden), but was not allowed to do so by the Government engineer of the



THE RIFFLES USED AT THE VISSENNIJ GOLD MINE

district, because this kind of underground work had not been provided for in the mining regulations. I presented reports to the Minister of Commerce and Industry and to the Mining Council at St. Petersburg, pointing out the importance of the method for the security of the miners in gaining control over the caving of the ground, and for the conservation of the forests in the mining districts. At last, after many months, my solicitation was acted upon, and an amendment to the existing mining law was promulgated to that effect. It may be of interest to add that, pending my solicitation, an incident happened that accelerated the granting of the permission. During a

very dry season, which had been continuing for about two months, cracks occurred in the ground, and this led to the sudden sinking, to a depth of about four feet, of a vast area, 400 ft. long and 300 ft. wide, which collapsed in spite of the strong timbering of which Mr. Hutchins writes with so much irony. The timber was placed according to the best mining practice, but it was entirely smashed; the compression of the air resulting was so strong that loaded trucks in the main tunnel were moved a distance of 100 ft., and a pile of boards lying at the mouth of the inclined shaft was thrown a distance of 50 ft. Fortunately, the incident occurred just when the men were all in the main tunnel on their way to the shaft and going out for dinner; they were all knocked to the ground, but nobody was hurt. This case, however, induced the Government engineer to support my solicitation, and the long-pillar drifting system with artificial caving and recovery of the timber was applied to the Schouvaloff mines. Subsequently, when I was appointed general manager for the Lenskoie Gold Mining Co., this system of drifting was introduced at their mine also.

The improvements mentioned have had a great influence in reducing cost and increasing production, but the record output of 1915 was due mainly to the extensive preparatory work done by Russian engineers during the two preceding years; to the extraordinary richness of one portion of the Bodaibo placer at the junction of the Bodaibo creek and its left tributary, the Dogaldin, which yielded as much as 103½ oz. per cubic yard; and to the discovery by myself, in face of strong opposition by the Lenskoie board of directors in Petrograd, who were opposed to prospecting there, of an extensive and extremely rich gold-bearing channel in the Bolshoi Chanehik creek, which during the first year's operation yielded 15½ oz. per cubic yard. Mr. Purington is well informed as to this, being at that time consulting engineer to the Lena Goldfields, then the biggest shareholder in the Lenskoie company. As to its future, I cannot agree with him. In my opinion there are still great reserves of precious metal in the property.

The criticisms that American observers bring against Russian placer methods relate chiefly to the inefficiency of labor, timbering and drifting methods, washing plants, prospecting methods, technical management, and administration.

DUTY OF LABOR. There is a general opinion among English and American engineers that the Russian laborer is inefficient as compared with the American or Alaskan miner, the duty of whom in open-cut work, according to Mr. Purington, is from 2.75 to 7.5 cu. yd. per man per 10 hours in shoveling into sluices. This kind of work may be compared with the open-cut work on Siberian placers, when the gravel is shoveled into two-wheeled one-horse carts. The laborers on the Siberian placers are organized into gangs of seven men, of which two (generally lads of 16 to 18 years of age) do the carting; and the other five, the excavating and shoveling. The output of such a gang is seven cubic sagues (89 cu. yd.) excavated and transported to the washing plant, which

means 17.8 cu. yd. excavated and shoveled per man per eight or nine hours. This is by no means an exceptional record, as it represents the average stipulated in the contracts drawn up between mine owners and laborers in all placer mining districts of Siberia. The best gangs often have a duty up to 8.5 cu. sag. (108 cu. yd.), or 21.6 cu. yd. per man. Admitting, owing to the cleverness of the Siberian miners in moving benchmarks, as alleged by Mr. Hutchins (which, however, is not the general rule), that the bank measurement is only about two-thirds of the excavation recorded, then the duty of the Siberian miner is still 11.8 to 14.4 cu. yd. per man, a record entirely unknown in Alaska, and, I believe, unrivaled throughout the world.

In the Ural the output of labor is less than in Siberia, varying with height of face and character of the gravel and the bedrock, from 4.8 to 8 cu. yd. per man per 18 hours in excavating and shoveling into cars and shifting the tracks nearer the face once every shift. The duty mentioned is from 12 years' observation, and represents the work actually done. The volume of ground excavated is determined by profile-leveling for cross-sections of the cutting. The smaller duty of the Ural miners as compared with that of the Siberian is due in some measure to physical inferiority, but mainly to the delays that occur more frequently in tramming than when transporting by carts moving independently one from another. At the mines of the former Cabinet of the Tzar in the Narehinsk district, the duty of labor in open-cut work was from 5 to 6 cu. yd. per man^o per 10-hour shift. In underground drifting, the average duty of labor in the Urals, as well as in Siberia, is about 2.5 cu. yd. per man per 8 hours. Special shovelers dispose of the broken ground in Californian and Alaskan drift mines, and the miner only does the breaking; but the Russian drift-miner fetches the timber from the stacks on the surface, lowers it by hand-windlass, hauls it to the face, trams the gravel to a siding, and close-timbers the drift with three-piece sets (two posts and a cap). The Russian's performance can, I believe, compete with the average duty of the Alaskan miner of 5 cu. yd. per man per shift. Foreign engineers, comparing the productiveness of labor in Russia and America, respectively, generally report a lower duty of the Russian than mentioned herewith, and this is because the Russian method of compiling records differs from American practice. The statements of foreigners are based on the totals of the final cost-sheets in which, according to Russian accounting practice, all the men connected with excavation work (miners, trammers, switchmen, tracklayers, drivers, hoisters) are recorded under the same head. In dividing these totals into the volume excavated, the resultant duty per man is, consequently, far less than the actual duty of the miners only.

The efficiency of labor has decreased considerably all over the world, and the outputs mentioned relate to normal pre-war times. At present, the Russian miner, no doubt, deserves an honorary membership among the I. W. W. Labor efficiency in times past, combined with the low rate of wages, resulting from the low cost of

living, is the chief cause for the limited application of excavating machinery in Russian placer mining, not ignorance and prejudice as suggested by many foreign observers. Had labor been as cheap in America as it was in Russia and Siberia, the application of machinery on American placers would not have reached its present state of development. Another important reason to account for the limited adoption of machinery in the operation of the Russian placer mines is lack of capital, which will be discussed later. About ten years ago the stripping of overburden on the Ural platinum placers cost 1.50 to 2.00 rubles per cu. sag., from 6 to 8 cents per cubic yard, including excavating and transporting to the dumps with the laborer's own horse and cart. Mining gravel in open-cuts, including transport (generally a distance of from 400 to 500 yd.) and dumping into washing apparatus under the same conditions, cost from 7 to 9.45 cents per cubic yard. In the Semipalatinsk and Altai districts, gravel was mined and shoveled into carts or trucks at an expense of from 2.5 to 3c. per cubic yard, the wages being 8 to 10 rubles per month per man, with board and lodging, making a total of from 14 to 16 rubles. In the remote Yenisseisk and Amur districts, where labor and supplies were considered expensive at that time, gravel was excavated, transported a distance of 250 to 400 yards, and dumped into the washing apparatus at a cost of 9.5 to 12 cents per cubic yard. It would have proved a hard job at that time to beat these records, even with the best mechanical equipment. The Trans-Siberian railway did not exist, and the transport of machinery involved enormous expense. For instance, a locomobile engine, the price of which was 8000 rubles, cost 20,000 rubles to transport to the Bargusin placers, north-east of Lake Baikal.

With the Siberian methods of operation, there is no heavy expenditure for the purchase of machinery; no stock of spare parts, no mechanical shops for complicated repairs are needed; and no delays are caused by breakage—an important item when the working season is only 100 days in the year. Moreover, the Siberian methods, though primitive, have the great advantage of flexibility; making it possible to increase or decrease, as the case may require, the number of faces where work is being carried on. The Russian mine-owners and engineers are not altogether to blame for their reluctance in adopting American methods and ways, such reluctance being fostered by the numerous failures of the British-American undertakings in Siberia. Mining is not merely a matter of engineering, but also one of arithmetic. Foreign observers often criticize Russian engineers for not introducing the latest improvements in the way of machinery, forgetting that machinery works to full advantage only if adapted perfectly to the local conditions. An over-engineered undertaking may yield returns as unsatisfactory as those resulting from the retention of primitive methods. A striking example is represented by what was known as the Kolehnan mines of the Orsk Goldfields, Ltd., on which American engineers erected two electric dredges and installed a power-plant about 15 miles from the mines. The

power-plant is using from 10,000 to 15,000 cu. sag. (roughly, 26,000 to 40,000 cords) of wood per operating season. There is no plausible reason for adopting electric dredges for use in a locality where wood fuel is plentiful. The Russian procedure would have been to erect two steam-dredges, consuming together not more than from 5000 to 8000 cords of wood. These, being self-contained, would operate independently; whereas in the event of stoppage of a generating plant, two electric dredges would be inactive simultaneously. I think that the shareholders of the Orsk company would greatly appreciate the advantages of steam dredges in this particular case.

(To be Continued)

CANADA'S metal and mineral production during 1920 has been valued, according to a preliminary report, at \$217,775,080, which is greater than the total reached during any preceding year. Compared with the production in 1919, valued at \$176,686,390, an increase of \$41,088,690 or 23.3% is shown, and compared with 1918, the previous maximum year, the increase is \$6,473,183 or 3%. The evidence toward the close of a year of economic depression, falling prices, and restriction or complete cessation of operation at numerous points, tended to monopolize the public mind, and to divert attention from the fact that Canada's mining industry during 1920 had furnished an output, the value of which was greater than had been attained in any previous year. During the past year there has been a quick recovery in the production of copper, nickel, and zinc among the metals. Gold production has continued to increase during each of the past two years, though the increment has been small. Canada occupies an almost unique position in being perhaps the only gold-producing country which has not shown a serious decline in the production of this metal. In zinc, asbestos, and coal, the highest pinnacle of production has been reached during the year just closed. Graphite, magnesite, and pyrite have not been in strong demand, but the production of these, as well as of chromite, gypsum, fluorspar, mica, and salt, have not only been well maintained but have been materially increased. The production of feldspar has been more than doubled. With the exception of silver, metal prices were well maintained throughout the first nine months of the year, copper holding during this period at slightly above the average of the previous year, lead at about 50% above the average of 1919, and zinc at 30% in excess of the previous year's average. Toward the end of the year, however, market conditions appeared to indicate the accumulation of excessive stocks, and the crash in metal prices during October, November, and December showed the desire of holders to unload. The fall in silver prices began in January and was accelerated in October. The severe price decline has resulted in the recent closing of a number of mines. Some of these must perforce remain closed or work at part capacity until exhaustion of accumulated stocks restores the market demand; or until the operators are able to reduce costs and so meet prevailing prices.

Karl Eilers v. Guggenheims

233 Broadway, New York City.

February 24, 1921.

To the Stockholders of

American Smelting & Refining Company.

Gentlemen:

In view of the approaching Annual Meeting and the appeal of the Messrs. Guggenheim for re-election to office and control, it seems necessary to emphasize certain facts in relation to the company.

The following shows the stockholdings of each member of the Board of Directors. This record is taken from lists recently furnished by the company:

The Guggenheim Family		Total Stock Holding	
Daniel Guggenheim	100	shares	} 1 averaging 81 shares each
Isaac Guggenheim	123	"	
Simon Guggenheim	100	"	
Roger W. Straus	1	"	
Total		324	shares
Salaried Employees			
Hamilton Brush	none		} 17 averaging 10 shares each
F. H. Brownell	5	"	
Charles Earl	40	"	
L. G. Eakins	10	"	
John C. Emison	5	"	
H. A. Guess	none		
William Loeb, Jr.	17	"	
W. E. Merriam	8	"	
H. A. Prosser	10	"	
F. R. Raft	5	"	
E. R. Reetz	12	"	} 5 averaging 369 shares each
C. W. Whitley	10	"	
John Steel	5	"	
G. P. Bartholomew	none		
W. S. Morse	10	"	
H. R. Wagner	10	"	
H. W. Vork	24	"	
F. W. Hills	148	"	
E. L. Newhouse	700	"	
W. M. Drury	300	"	
Walter T. Pace	600	"	
C. A. H. deSaullies	100	"	
Total		2,010	shares
Directors not employees			
E. B. Schley	100	"	} 101 "
W. S. McCormick	1	"	
Total		101	shares
Total shares owned by entire Board of Directors		2,444	shares
Average 88 shares each			
Out of a total of		1,100,000	shares

In 1905, 1906 and 1907 the American Smelting & Refining Company appeared to be at the height of its prosperity. Its common stock commanded 174 dollars per share at the New York Stock Exchange. With its splendid credit its officers could readily have financed for its account any of the opportunities that were presented to obtain interests in Utah Copper, Nevada Con. or Kennecott, and later in Chile, but instead the Guggenheims, although they were officers of A. S. & R. Co., and in receipt of large salaries therefrom, took these opportunities for themselves.

In the case of Utah the amount expended by the Company to build a smelter to treat the ore was greater than the Guggenheim investment in the mines, but the great profit has not come to A. S. & R. Co. Utah has paid 101 million dollars in dividends, it has a surplus of over 49 million dollars and the ore reserves are 368 million tons. It is the most profitable mine in the world.

Nevada Con. and its plant and railroad could easily

have been financed for account of A. S. & R. Co. It has paid dividends of 45 million dollars and has a surplus of 8 millions.

The Bonanza properties in Alaska were obtained in 1906 for a moderate investment well within the financial ability of the A. S. & R. Co. This has become the Kennecott which is a 117 million dollar corporation which has already distributed over 49 million dollars in dividends.

Chile copper was obtained about the year 1911—it is the greatest mine in the world. An initial expenditure of about \$200,000.00 by the Guggenheims through their Chile Exploration Co. confirmed an enormous tonnage, which they at once capitalized at 110 million dollars.

Had these four properties been taken over for account of the American Smelting & Refining Company, as they should have been, the stock of the company would have been worth many times what it is to-day.

In the statement issued by President Guggenheim, January 20th, it is indicated that the American Smelting & Refining Company did not participate in the above mentioned ventures because they were "distant and hazardous enterprises". This amazing and misleading statement is made in the face of the fact that while this Company was deprived of the opportunities above indicated, the Guggenheims unloaded on the company various mining properties in Mexico and other distant places and took from Smelters about 22 million dollars in cash and its equivalent, but the return to A. S. & R. Co. has been an utterly insignificant sum compared with the profits the Guggenheims derived from the four copper properties mentioned.

Recently the agency for the sale of copper from the mines of Utah, Nevada Con., Chino, Chile, Braden, Ray, Beatson and Kennecott was transferred without consideration from A. S. & R. Co. to Guggenheim Brothers, thus depriving the company of commissions of over one million dollars a year. The attempted explanation fails utterly in the light of the language of the contracts which fully protected the A. S. & R. Co. if President Guggenheim and his brothers had but observed the terms and refrained from gambling in copper.

The "Financial World" of New York has issued a letter stating it is about to publish an independent analysis of the affairs of American Smelting & Refining Company. This letter was no doubt inspired by and mailed through the Guggenheim office, the envelopes being actually addressed on the company's addressing machine. The analysis can hardly be expected to state the facts or be independent.

The management has asked the stockholders for proxies giving them authority to vote for the "ratification of all actions of the Board of Directors and all Committees thereof." As these matters may be reviewed in the courts I earnestly advise stockholders not to throw away their rights by giving proxies to the present management to be voted to ratify their remarkable transactions, many of which may not as yet even have come to our notice.

Respectfully,

KARL EILERS.

The High-Level Diamond Deposits of Brazil

By A. M. Pontie

*Diamonds were first discovered in Brazil in 1729, at Tijuca, in the State of Minas Geraes. They were found in two distinct varieties of deposits: In recent gravels, or ancient river terraces; and in high-level areas, and considered by many to be conglomerates of fluvialite origin.

Diamonds are also found in the beds of many of the rivers of Brazil, the principal of these being: the Jequitinhonha, near the town of Diamantina; the Bagagem, Somno, São Antonio, Prata, Abaeté, and São Francisco, in Minas; the Paraguassú, in the State of Bahia; the Tibaji, in Paraná; and many streams in Matto Grosso and Goyaz.

High-level diamond-bearing deposits exist in many of the upper basins of these rivers. The best known are São João de Chapada, Dattas, Serrinha and Bôa Vista, near Diamantina; Grão Mogol, about 120 miles further north; Agua Suja, near the town of Bagagem; and Leneoes, in the district of Bahia. The majority of these high-level deposits are situated on the dividing ridges of the streams, several hundred feet above the present river valleys.

The discovery of diamonds in the high-level deposits dates from 1834, when an old slave woman found a large stone embedded in blue clay; this led others to investigate the formation, with the result that the locality, São João da Chapada, has been worked with satisfactory results. For a number of years before this discovery, no attempt had been made to ascertain the source of the precious stones. The richness of these gravels, and the cheapness of the slave labor available, probably satisfied the owners; and, no doubt, lack of initiative and curiosity deterred them from studying the problem more fully. Prospecting in a country like Brazil is not easy; the lack of roads, the dense forests and thick undergrowth handicap the traveler, and the country is covered to a large extent with a thick coating of surface soil which obscures the underlying rock formation. Moreover, the insect pests which abound make miserable the life of the explorer.

The most important high-level deposits so far located are situated in the Serra do Espinhaço. This range of mountains extends northward from Ouro Preto to Joazeiro, a distance of about 620 miles, with a width of nearly 40 miles in its widest section. Some of the rivers rising from the higher eminences of this Serra have yielded the majority of the diamonds produced.

The Serra do Espinhaço is flanked on the west by the valley of the Rio São Francisco, and on the east by the granitic and schistose foot-hills, which extend to the Atlantic; the general altitude is about 1500 ft. above sea-

level, though many of the peaks rise to 4600 ft. The Serra is composed of a series of rocks, consisting of alterations of quartzites, with yellow and gray shales. These different beds occur throughout the series. The general dip of the strata is to the west toward the valley of the São Francisco, though it frequently alters and a reverse dip occurs. Where unweathered, the quartzites consist of a hard mass, made up of minute rounded grains of quartz; but where affected by considerable weathering the quartzite is altered into soft sandstone. The quartzites and sandstones are stratified and false-bedded, the interbedded shales are laminated and generally slaty in structure. Gold sometimes occurs in quartz veins, which are abundant in both the quartzites and shales. There are also thin layers of quartz conglomerates interbedded in the quartzites. The Espinhaço quartzite near the town of Diamantina, where extensive weathering has taken place, shows many lines of faulting, slightly-inclined beds butting up against vertical or overturned strata. These phenomena are evidence of enormous pressure.

The most important, though perhaps the least known, high-level diamond-bearing deposits of the Serra do Espinhaço are Serrinha, Bôa Vista, and São João do Barra. The Serrinha deposit is situated eight miles south-east from the town of Diamantina. It lies on the crest of a mound, situated at the foot of a vertical cliff formed by the uplifting of the Serra do Espinhaço. The diamond-bearing ground covers an area of about half a square mile. Owing to lack of water, and the altitude of the deposit, regular and continuous work is not being carried out. The ground is well exposed by the existing cuttings and pits, in many places to a depth of over 40 ft. From careful examination of the walls of these cuttings it is evident that the deposit is a breccia consisting of boulders of soft sandstone, seldom more than 1 ft., or less than 3 in. diameter, angular in shape, with blunted corners. These boulders, some of which are flat and stand on edge, are embedded in a blue-gray mass, which contains a few rounded pebbles of quartz, no doubt derived from the conglomerate beds in the Espinhaço quartzites. The boulders rarely touch one another, and are completely surrounded by the cementing mineral. Small veins of iron oxide running through the mass are not uncommon.

The breccia has the characteristic of being able to stand in a vertical position. Clear faces, 200 to 300 ft. in length by 40 ft. in depth, are exposed to view. The whole mass of mineral is soft, and readily disintegrates under the influence of a stream of water from a hydraulic nozzle at 50 lb. pressure.

The diamonds are white and of good quality; 4 and 5-carat stones are frequently recovered, and few found are under one-sixth of a carat in weight.

*Abstracted from 'Trans. Inst. Min. & Met.'

Bôa Vista is situated 12 miles east from Diamantina and 8 miles south west from Serrinha. This deposit is in many respects similar to the one at Serrinha, except that the sandstone boulders are smaller and softer. The cementing material, as far as can be ascertained by present indications, is of the same formation and character but there is a considerable difference in the quality of the diamonds; they are smaller, and a higher percentage of defective stones is encountered.

Recently an Anglo-Brazilian company purchased the property, and modern methods of extraction are being employed with gratifying results.

The area of the diamond-bearing ground is about 2 square miles. The deepest workings are at a depth of over 100 ft., and no indications of a change in the formation in the breccia are noticeable. Tests made of the cementing material indicate that a large part of it was originally composed of olivine. So far no olivine-bearing rocks have been found in the vicinity, though diligent search has been made in the district; it is, therefore, apparent that the cementing material in the breccia must be derived from some source other than the surrounding rocks.

São João do Barro is situated 20 miles north-west of Diamantina and 12 miles north-west from Guinda railway station. This deposit is the highest in the district, 5000 ft. above sea-level. In many respects it resembles those at Serrinha and Bôa Vista, inasmuch as the breccia consists of angular boulders and slabs of decomposed sandstone, with a few small pieces of shale and schist, derived from the surrounding rocks. This formation is better defined than at the other two localities.

The area covered by the breccia is about one square mile. The deposit has been tested in several places to 150 ft. in depth without showing any alteration or change in the minerals contained in the breccia. The cementing material is highly basic, containing tale and magnesia in large proportions; but owing to the presence of the quartzite surrounding the deposit, which retains the water collected during the heavy rains, the minerals in the breccia are decomposed to such an extent that they are barely recognizable; and, until a greater depth is attained, it will be impossible to determine the composition of the various minerals which form the cementing mass. This deposit has been worked for many years and has yielded the best quality of diamonds of the district. The stones are of a clear blue-white color and of good shape, and realize the highest price per carat obtained for local diamonds.

Situated on the extreme eastern edge of the ring of out-cropping quartzite is a cutting 1000 ft. in length by 300 ft. in width, with a depth of 150 ft., exposing the different layers forming the last ring or wall of the breccia. The quartzites of the neighborhood have a dip of from 15° to 20° east, but on the edge of the breccia at this point, the dip is 45° east, thus showing that, at some period, local and violent disturbances have taken place, uptilting the strata at an acute angle.

Hitherto these deposits have been described as con-

glomerates of fluvial origin, but aqueous conglomerates are totally different from those described at Serrinha, Bôa Vista and São João do Barro. In river conglomerates, the cementing material filling the interstices between the boulders contains a large percentage of the same material as the boulders themselves, and these consist of various kinds of rocks which are derived from the different strata through which the stream flows. The boulders are invariably rounded, except those which are derived from the rocks of the immediate vicinity, but the contrary is the case in the high-level deposits described, where the boulders are all of the same rock, whereas the cementing material is of a totally different nature from that of the boulders. Another reason why these deposits are not of fluvial origin is that, in all such gravels and conglomerates, which contain minerals of higher specific gravity than the cementing material, local enrichment takes place, and rich shoots and pockets are formed. This is not so with the deposits in question, where the diamonds are found indiscriminately scattered throughout the cementing mass.

As the mass contains a considerable amount of olivine, it is obvious that these deposits must be derived from some deep-seated source, either through volcanic or thermal action. The former hypothesis seems to be the more probable, especially in view of the fact that undecomposed blue-ground Kimberlite has been discovered in Brazil at two different localities which are many miles apart. This fact, together with the above-enumerated reasons, makes it apparent that these high-level deposits are not conglomerates of fluvial origin.

THE 'big-mill' policy which attained so much vogue on the Rand a number of years ago is considered by many to have been proved a mistaken policy. G. A. Denny is quoted as saying: "The feature of Rand mining economics salient in the past decade is the utter failure of large milling equipments, working on small margins of profit, to justify expectations, either in the direction of reducing cost below that which is shown by some of the oldest and earliest equipped of the mines, or in earning the profits which it appeared natural to expect from such elaborate and expensive installations. Their failure is a complete demonstration of the absence of some vital element necessary to the success of large-scale operations, in the majority of instances and arises from an improper ratio between accumulated ore-reserves of a certain minimum value and equipment at the commencement of the period of large-scale operations, or the impossibility of maintaining the reserves at a safe ratio after milling began. It would be invidious to mention the notorious instances of prosperous, moderately equipped companies whose fortunes were prejudiced by the adoption of operations on a very large scale, or to compare the financial results they have achieved before and after the change from a scale of operations well within the productive powers of the mines, and one that has proved to be beyond those powers. It is for succeeding companies to analyze the causes of failure, and, if possible, to avoid them."—'Financial Times'.

REVIEW OF MINING

SAN FRANCISCO SECTION, A. I. M. & M. E.

At the regular monthly meeting of the San Francisco section, held on the evening of March 8, C. H. White and Augustus Locke presented two related papers on 'The Need of a Quantitative Method of Mining Geology'. They urged the development of organized technique for the benefit of those members of the profession whose business it is to 'find' ore. At the business meeting preceding the reading of the papers, the attention of the members was drawn to a recently started lawsuit in which a mining engineer seeks to recover a commission alleged to be due for negotiating the sale of mining property. His client calls attention to a statute, enacted in 1919, which provides that in the State of California no one but a licensed real-estate dealer can 'lawfully' negotiate the sale of land, and therefore claims that the engineer has no standing in court. This is the first time that the law has been invoked to avoid payment of a commission. The secretary of the San Francisco section was instructed to communicate with State Senator Gates, of Pasadena, who has introduced a bill to amend the statute for the purpose of protecting lawyers, urging him to include a provision whereby the services of a mining or metallurgical engineer, in his professional capacity, may not be affected by the law.

EARNINGS OF STEEL COMPANIES FOR 1920 WERE GOOD

Five of the larger steel companies have now reported for 1920. Notwithstanding the depression toward the close, the year proved to be a good one from the standpoint of earnings. The steel industry opened the year with a most promising outlook. The strike in the latter part of 1919 had resulted in a shortage of production which carried the demand over into 1920. This condition, coupled with the outlaw railroad strike, which restricted output and curtailed shipments in the spring, delayed the reaction in steel until September, by which time many other basic commodities were in the throes of liquidation.

The greatest improvement over 1919 is shown by the Lackawanna and Republic companies. This comparison, however, reflects the less advantageous conditions under which these companies operate, as they do not enjoy the diversity of output possessed by United States Steel and Bethlehem. This condition made for very poor earnings in 1919, and heightened the comparison with 1920. Bethlehem earnings show little change, probably due to the large proportion of highly finished products made by the company for which the demand has been well sustained, and to earnings from its shipyards. It is understood that the three large shipyards of the corporation have sufficient work on hand to ensure reasonably full operation throughout the year.

United States Steel earnings reflect the general conditions pertaining to the industry. The steel business for 1920 is probably accurately gauged in the 60% increase in earnings of this company over those of 1919. The outlook for the first half of 1921 at least, does not seem to warrant the expectation of a continuance of the 1920 earnings. The steel industry now finds itself in an era of price-cutting by inde-

pendents, hesitation on the part of purchasers, a falling demand for steel, wage adjustments, and operations curtailed to about 50% of capacity.

CONSUMPTION OF PETROLEUM IN JANUARY

January 1921 scored a new record for consumption of domestic and imported petroleum when 49,651,000 bbl. was delivered to consumers, chiefly refineries, an increase of 756,000 over the highest previous monthly consumption of November 1920, according to U. S. Geological Survey. January consumption averaged 1,601,645 bbl. daily, against daily average of 1,629,833 in November 1920. Estimated domestic crude petroleum delivered to consumers in January totaled 37,490,000 bbl., against 36,596,000 in December. Imports of crude oil from Mexico were 13,193,000, a high record, and 347,000 more than in December. Crude-oil production in United States in January was 38,271,000 bbl., against 38,961,000 in December. Stocks of domestic and foreign crude oil increased in January about 1,077,000 bbl. Net stocks of domestic crude east of California increased 450,000 bbl. and in California increased 450,000 bbl. California stocks gained 331,000. Stocks of Mexican oil held by importers increased 296,000.

NEW REDUCTION PLANT AT WINNEMUCCA, NEVADA, STIMULATES PROSPECTING

The activity of the Silver State Chemical Co., which is arranging for the building of an ore-reduction and chemical plant at Winnemucca, is stimulating mining and prospecting operations in this region. Many prospectors and claim-owners are preparing to go into the different districts and a good many are at work on claims on the near-by hills. There are practically unlimited quantities of minerals to keep a much larger plant in operation than the one contemplated at this time. W. A. Zimmerman, business manager for the Silver State Chemical Co., has been in San Francisco conferring with machinery men and attending to other business connected with the construction of the plant. In the laboratory of the company, L. E. Sowers, who will have charge of the reduction plant, is busy making tests of the many ores and mineral samples coming in. The first unit of the plant consists of leaching-equipment for the purpose of treating lead and zinc ore for the making of pigments. The recovery of mercury in the form of nitrate from cinnabar is also projected.

ENGINEERING COUNCIL OF UTAH IS FORMED

A new organization, known as the Engineering Council of Utah, modeled after similar bodies in Cleveland and St. Louis, has been formed at Salt Lake City. The purposes of the organization are:

1. The affiliation of engineering societies.
2. United consideration of and action on matters of common concern to engineers, as well as matters of public welfare embodying the application of engineering principles.
3. The advancement of engineering knowledge and practice.
4. The maintenance of a high professional standard among engineers.

5 The correlation of the local activities of engineering societies.

In order to accomplish these purposes and to bring the engineers of Utah into active touch with one another, the Engineering Council of Utah will be directed by a governing board consisting of two representatives from each of the member societies. The governing board, as represented at the first meeting of the council, included the following men: American Society of Civil Engineers, R. K. Brown, Theodore A. Beyer; American Institute of Electrical Engineers, Joseph E. Merrill, Paul P. Ashworth; Utah Society of Engineers, Hylom T. Plumb, A. C. Watts; American Institute of Mining Engineers, Henry M. Adkinson, Edward R. Zalinski; American Association of Engineers, Charles J. Ullrich, Charles S. Fisher; American Society of Mechanical Engineers, Louis J. Seckles, L. Douglas Anderson. Temporary organization was effected by the election of Hylom T. Plumb as chairman and Theodore A. Beyer as secretary.

HOLLINGER MINES SUES POWER COMPANY FOR FAILURE TO SUPPLY ELECTRIC POWER

A further cut has been made in the supply of electric power to the mines. The Hollinger Consolidated is now getting only 1500 kw., as compared with its full requirements of over 10,000. The mill is operating at about one-third capacity, treating an average of some 1300 tons per day, and is able to maintain this rate by means of its auxiliary steam-equipment, the extra cost of which is stated as between \$800 and \$900 per day. The company has entered a suit for damages against the Northern Canada Power Co. in the Supreme Court on account of the losses sustained through shortage of electric energy. As power shortage has been general in all the mining camps the case excites widespread interest.

ST. JOSEPH LEAD CO.'S REPORT FOR 1920

The financial statement of the St. Joseph Lead Co. for 1920 shows: net income, \$4,813,512; depreciation, \$1,802,086; balance, \$3,001,426; cash dividend, \$2,889,436; surplus, \$121,990; total surplus, \$12,107,083; stock dividend, \$1,409,466; final surplus, \$10,697,617. The consolidated general balance sheet as of December 31 shows cash amounting to \$1,681,917, accounts and notes receivable, \$622,529; materials and supplies, \$744,793; lead on hand and in process, \$853,904; accounts payable, \$658,448; reserves, \$1,614,277; total assets and liabilities, \$30,827,214.

QUEEN MINE NEAR SALMO, B. C., IS BONDED

An important mining transaction is the bonding of the old Queen mine, near Salmo, B. C., to C. H. Cassill, of Spokane. The consideration is \$150,000. The mine was located in the late 'nineties and was worked continuously up to 1915, when a serious cave occurred in the main winze, and operations were suspended. Up to this time the mine had produced slightly more than one and a half million dollars worth of gold ore. About two years ago the property was bonded by A. W. McCune, and a long tunnel was driven, but the result appears not to have been satisfactory, and the bond was relinquished. Recently the mine was examined by J. C. Haas, of Spokane, for Mr. Cassill, and the present option has resulted. For more than a year Mr. Cassill has been exploring the Ore Hill group, which adjoins the Queen, and he is confident that he has discovered the Queen vein on that group. At the bottom level in the Queen the vein is exposed for 800 ft., varies from 8 to 33 ft. in thickness, and is said to average \$9 in gold per ton. There is a 20-stamp mill on the property, and ample water-rights on Wolf and Sheep creeks go with the property. Mr. Cassill will form a company to be known as the Queen-Ore Hill Mines,

Ltd., with a capital of \$250,000. He is backed by Eastern capitalists.

ALASKA

Hyder.—A remarkably rich shoot of silver-gold ore is the latest discovery at the Premier mine. A stringer 12 in. thick, containing native silver and free gold, was found passing through a body of high-grade ore. The Premier has always been considered a silver mine, so the finding of gold in considerable quantity is of special interest.

ARIZONA

Wisbee. The Junction shaft of the Calumet & Arizona company, now 2385 ft. below the surface, is the deepest in the Warren district. The nearest competitor is the Dallas shaft of the Copper Queen company, which will be 2200 ft. deep when completed. Considerable work remains to be done in cutting stations and ore-pockets. The pumps are now delivering 3250 gal. of water per minute.

Douglas.—The Calumet & Arizona company produced 3,502,00 lb. of blister-copper during the month of February, according to returns from the smelter.

Hill Top.—The lower adit of the Hill Top Metals company has reached a point 3600 ft. from the portal. The veins cut by the upper tunnels should be reached within the next 200 feet.

Jerome.—In a recent interview Charles W. Clark, general manager for the United Verde Copper Co., stated that, "although we are operating at a heavy loss with copper at the present price and with existing costs of production there will be no further curtailment of forces or production, notwithstanding the fact that we have been solicited to close the mine and the smelter completely". He also stated that the company has over 40,000,000 lb. of copper on hand at the smelter.

Kingman.—It has been announced by the Thumb Butte Gold Mining Co. that an industrial town involving the expenditure of \$1,500,000 is to be built at its property. The construction work is to consist of more than 500 houses, a library, school, church, picture theatre, and other buildings of a modern community. The company, of which C. H. Manville of Johns Manville company is president, owns 40 claims situated near Union Pass in the favorable district between Oatman and Kingman. Over \$200,000 has been spent by the company in development work whereby a large tonnage of gold ore of good grade has been proved.

Mayer.—The new vertical shaft of the Kay Copper Co. has reached a depth of 280 ft. and is progressing at the rate of 100 ft. per month. The shaft is to be sunk to the 800-ft. level. In addition to this work other development is being carried on; 30 men are employed. No attempt at production will be made until the development is further advanced.——A new 80-ton mill is being erected at the Gloriana mine south of Mayer. The Gloriana mine is one of the oldest mines in the district having been worked under the name of the Valencia mine years ago. According to the owners a large tonnage of gold ore has been proved.——The Arizona Copper & Mining Co., owner of the Gillespie mine, is to erect a mill. Sufficient ore has been developed to run the mill for a year.

Oatman.—The drift on the 720-ft. level of the Red Cloud mine of the Tom Reed Gold Mining Co. has advanced into the orebody recently discovered on that level. A sample taken across the face of the drift is reported as assaying \$19 gold per ton. The orebody appears to be large, and sinking to the 800-ft. level is planned. Development work at this mine was only recently resumed after the shut-down caused by the strike in 1919. The ore is said to resemble that of the United Eastern. This development of ore in the most westerly claim of the Tom Reed property is important, par-

ticularly to the United Eastern, whose claims practically surround the Red Cloud claim.

Recent developments at the Katherine mine in Union Pass has started a revival of interest in the district and many mining claims have changed hands in the past week. Ore has been opened in a drift 130 ft. below the outcrop of the Gold Chain mine. The drift is being advanced with cross-cuts every 50 ft. The ore is said to resemble that of the Katherine. It is reported that there is now 100,000 tons of ore developed. C. F. Nourse of Kingman is superintendent. —C. M. Miller of San Francisco and associates have acquired a large group of claims surrounding the Katherine mine. The Katherine Extension Mining Co. is being organized to operate these properties. —A vein 18 in. wide carrying high-grade copper-silver ore has been opened in the Great Republic mine in the Cedar Valley district, according to reports from the property.

During the year 1920 the United Eastern mine earned 90c. per share, according to the annual statement of the company recently mailed to stockholders. December proved the best month of the year, the grade of ore treated setting a new record. The 8875 tons of ore milled had a gross value of \$241,435, equivalent to \$27.20 per ton. As \$233,651 was recovered, and as operating costs amounted to only \$85,355, an operating profit of \$148,296 for the month was shown, equivalent to \$16.71 per ton. During the year the company milled 102,926 tons of ore of an average gross value of \$21.75 per ton and an aggregate gross value of \$2,239,711, as compared with \$2,031,594 the year previous. Operating costs totaled \$942,261, or \$9.15 per ton, as compared with \$9.21 in 1919.

Patagonia.—J. B. Tenney, managing director of the Flux mine, states that a drift recently has been driven into the main carbonate orebody. Development work will proceed on the 130-ft. level.

Tombstone.—Walter Rushin has sold his interest in the Rushin and Hobbs lease on the Silver Cloud claims to J. S. Chambers of Tombstone. The Silver Cloud is 12 miles from Tombstone in the foothills of the Dragoon mountains. The vein is yielding ore that assays 20 oz. silver and 2 oz. gold per ton. Shipments to Douglas have been made for some time. —The Commonwealth mine at Pearce is now shipping about 30 cars of tailing and 15 cars of ore weekly to the Calumet & Arizona smelter at Douglas. The tailing was cyanided a number of years ago.

CALIFORNIA

Dutch Flat.—A satisfactory clean-up is reported by W. S. Bliss, of San Francisco, as a result of operations at his hydraulic mine on Liberty hill. One nugget worth \$56 was recovered.

Georgetown.—C. B. More and E. von Kotch are reported to have found a 2-ft. vein of high-grade ore in a 35-ft. shaft on a prospect near here. Some excitement prevails and numerous prospectors are at work.

Last Chance.—It is reported that \$1500 has been recovered in a 2-day run of rich gravel at the Glen mine. Frank A. Tillotson, lessee on the property, states that the gravel averages 2 oz. of gold per yard.

Nevada City.—Thomas Coan is prospecting the Debernardi mine at Indian Flat. He will cross-cut at the depth of 100 feet.

Oroville.—Operations are to be resumed at the once famous Steifer mine. A power-line has already been completed. It is hoped to tap the rich Mammoth gravel channel by means of the workings now being driven.

Sutter Creek.—The South Eureka mine, which has been shut-down for three years, has been optioned by the Central Eureka Mining Co. It is stated that the Oneida mine is not included in the option.

COLORADO

Aspen.—The discovery of rich ore in the Hope tunnel shows no sign of playing out, and with the shoot proved for more than 100 ft., the possibilities of ore, should the vein prove extensive in a vertical direction, are immense. Samples taken recently gave results as follows: No. 1, 237 oz. silver; No. 2, 48 oz.; and No. 3, 1244 oz. These samples were taken by a mining man not directly interested in the Hope company. —The Aspen Silver Lead Mines has an excellent showing of silver ore in the Deane tunnel on Porphyry mountain. —A Denver syndicate has secured a group of patented claims, adjoining the Aspen Silver Lead Mines group on the south and will put miners at work soon. —The Smuggler Leasing Co., operating the Leadville Mines and Varney tunnel group, is mining good silver-lead



ore, and carbonate ore assaying as high as 60% zinc. Heavy production will be made during the summer season.

Breckenridge.—The Royal Tiger Mines Co. is arranging to sink a deep shaft on the Minnie to develop its recently acquired Mineral Hill properties. —The Blue Flag company is continuing development at its Laurium property and the Laurium mill will shortly be completed. Large reserves of low-grade ore are available for treatment at the remodeled plant.

Central City.—The Frontenac group in Russel gulch, comprising eight patented claims, has been transferred to an Eastern syndicate.

Cripple Creek.—Following discovery of a new ore-shoot at the 1600-ft. level of the Cresson mine, it is officially announced, that "a rich find in ground heretofore undeveloped" has been made at the 1100-ft. level. —High-grade 'picture rock' is daily mined in drifting on the 2450-ft. level of the No. 2 Portland shaft, according to official reports. Both north and south drifts have been carried 100 ft. beyond the station, with both headings in ore. The company also announces the discovery of a vein new to the property at the 1200-ft. level, rich in gold. The water is being handled without difficulty, but duplicate electric

pumps have been installed to prevent flooding should one pump be out of order. A three-car lot shipped as broken from the 24 1/2-ft. level is reported to return \$24 per ton.

The Vindicator Consolidated Gold Mining Co. has cross-cut the Lily vein at the 2000 ft. level south of the main shaft and is now developing a good ore shoot. Samples assay from 15 to 20 oz. gold to the ton, with the ore breaking from 3 to 5 ft. in width. New orebodies are also being developed at the 18th and 19th levels of the main shaft. The Modoc Consolidated Mines Co. is producing and shipping a good grade of mill ore and the March production at the present rate of shipments to the Golden Cycle mill at Colorado Springs will approximate 5000 tons of ore averaging one ounce per ton. The Golden Cycle M. & R. Co. paid its stockholders a dividend of two cents on March 10. Total to date \$9,468,000.

Empire.—The Golden Empire Mining Co. has increased its force at the Arvada tunnel and is mining a good galena ore on the Arvada vein sampling \$10 to \$30 per ton. An additional 50-ton unit is to be added to the milling plant to be put in operation this spring, making the total capacity 100 tons daily.

Georgetown.—Mill construction is planned by the Nelson Leasing Co., operating the Silver Mountain mine, where large reserves of mill-ore are blocked-out.—The Colorado Power Co. this week turned on power to the Waldorf group for use of the Palisade Copper Co., operating this property.—The Bard Creek company is preparing to resume work on its Clear Creek property.

Idaho Springs.—The Silver Gem Mining Co. has leased under favorable terms the Silver Plume or Gold Belt tunnel group of seven claims developed by the tunnel now 2000 ft. in length. Three veins cut carry rich silver ore, samples ranging from \$20 to \$400 per ton, while a carload shipment returned \$100 per ton net. The original holdings of the company, the Silver Gem group near this city, are also being developed and are producing a good grade of silver-lead ore.

Leadville.—Stock in the Prospect Mountain tunnel project to the amount of \$21,000 having been subscribed, John Cortelling, manager, broke ground for the tunnel last week.—Silver ore assaying 100 oz. per ton has been found at a depth of 50 ft. in the shaft being sunk on the Fanchon placer, in the Sugar Loaf district, where surface ore returned from 4 to 5 oz. gold.

Ouray.—The Chipeta M. M. & S. Co. has resumed work on the H. A. C. property and will shortly connect with the Colorado Power company's line. Machine-drills have already been delivered. A vein 20 ft. between walls was recently opened at the 750-ft. level, and a milling plant is projected.

Pueblo.—The Marion Mining Co. owning properties and mill in the Greenhorn mountains, in the Rye section southwest of Pueblo, has shipped supplies from this point and plans to resume operations as soon as road conditions permit and warm weather melts the heavy snow of that section. The ore on the Marion group is zinc-copper, and when the property last operated some two years ago, the product was shipped to the Pueblo smelter for treatment.—Another property shipping to the Pueblo plant, the Farrel mine at Parkdale, has been leased to Salida operators who are already mining ore for shipment.

Silverton.—The Sunnyside M. & M. Co. sinking the Washington shaft, under contract, has made an important discovery, the contractors having opened a strong orebody, now proved 40 ft. wide, while sinking from the 200-ft. level. The ore samples \$160 per ton in lead, zinc, and copper.—The Silverton Northern, Gladstone & Red Mountain railroad is preparing to resume traffic over its snow-bound road, and with the road in operation work will be resumed at the Gold King, Gold King Extension, Dives, Kittimac, Greene

Mountain, Silver Ledge, Joe and John Champlon, and other mines, some of these on company account and others by lease.

The Red Mountain Silver Mines Co. plans the construction of a 500-ton mill. Cyrus L. Tripp has been retained as metallurgical engineer. The machinery is to be supplied by the Denver Quartz Mill & Crusher Co. J. J. Cusick is general manager for the company.

IDAHO

Coeur d'Alene.—The Gold Hunter company will await better conditions before mining and milling operations are resumed.—Mine managers throughout the Coeur d'Alene region are hoping for reductions in freight rates on both supplies and ore, and a deduction on the freight rate on pig-lead from the smelter to New York, which has been increased from \$6.15 to \$22 per ton.—The Clarinda mine at Clarks Fork will soon begin active development work.—Development work by a small crew of men is now going on at the property of the Silver Eagle Mining Co. adjoining the North Star group in the Nine Mile district.

Plans are under way for the resumption of work on the Jack Walte property on the North Fork. Extensive work there last summer disclosed a body of high-grade ore.—A force of miners will be put to work at once on the Big Hill and Silver Dale property consisting of 15 claims on Big creek, where a contract for extending the main adit 200 ft. has been let. The property is well equipped with machinery. The main adit is now 1100 ft. long.—The American-Commander Mining Co. has purchased a compressor and will install it as soon as the roads to the mine will allow heavy hauling. Besides air for its own work the company will furnish power to the Independence Lead Mines Co. and the West Hunter. The American-Commander has about 100 ft. to drive in the upper adit to cut the vein.

Machinery is being installed on the Lookout Mountain property. A compressor and engine-house has been completed and the machinery will be on the ground soon. The lower cross-cut adit will be carried forward to cut the vein at a depth of approximately 300 ft. A drift on the vein will then carry the work to a point beneath the ore found in the upper workings.—Two feet of clean high-grade silver-lead ore is now showing in the face of the east drift of the Chicago-Boston property. The ore is of the same character as that opened up in the main tunnel-level. The Chicago-Boston is being operated by the Callahan Zinc-Lead company.

The lower cross-cut adit at the Sterling Silver Mountain property in the Big Creek district of the Coeur d'Alene, has been driven more than 800 ft. and is being advanced steadily.

Arthur Connors, a millman employed by the Hunter Mining company at Mullan, has applied for a patent on a new type of flotation machine, the principal features of which are new methods of mixing oil and ore, and the application of compressed air to the pulp.

Hailey.—The Bunker Hill & Sullivan company has taken a leasing bond on the Bullion and Mayflower groups. More than 500 men were employed at the mines of the district in the 'eighties, when the production was reported to be upward of \$1,000,000.

Mackay.—It is reported that a 2-ft. vein of high-grade galena ore has been opened on the 350-ft., or lowest, level of the Doughboy mine. The mine is only about a year old. It has recently been equipped with a new oil-burning engine, hoist, compressors, and other machinery supplied by the Chicago Pneumatic Tool Co. Arthur N. Sweet is consulting engineer.

Pocatello.—The Hidden Treasure group, in the Little Smoky district, has been leased to Salt Lake City capitalists. A concentrator was built on the property some years ago.

and some high-grade galena ore was developed. Joseph Vogner will be in charge of the new work.

MICHIGAN

Houghton.—W. Parsons Todd, of New York, vice-president of the Quincy Mining Co., is here for a visit to the Quincy mine, mill, and smelter. He reports Quincy is making fair sales of copper but, like all copper producers, has a considerable surplus of metal. No change in policy in Quincy operations is planned, at least not at this time. Even though the market is not favorable, Mr. Todd is inclined to be optimistic rather than pessimistic of the outlook. It is his belief that the copper-mining industry has passed through its most trying period and that there will be a gradual improvement from now on, improving with the general business situation.

Calumet & Hecla has just completed the shipment of 150,000 lb. of copper for domestic consumers and is now loading 400,000 lb. for shipment to France.—Seneca is still cross-cutting through the lode preparatory to drifting on the 6th level. Drifting continues on the 3rd and 4th levels, north, and on the 5th level, north and south. The south drift is in splendid ground and the cross-cut also looks especially good. The north drifts are in fair to good ground.

Lansing.—W. F. Miller, representative from Houghton, has introduced a bill in the Michigan Legislature at Lansing to permit mining companies to produce manufactured articles made of copper. The direct reason for the bill is the consideration by Calumet & Hecla company of the establishment of manufacturing plants. Under present laws, local mining companies may not engage in manufacturing. Calumet & Hecla has not decided definitely to begin manufacturing, according to James MacNaughton, vice-president and general manager, but that it will be forced to do so ultimately, is his conviction. No opposition to the bill is looked for at Lansing. Illustrative of the condition confronting Lake Superior companies, Miller pointed out that while the mines break the rock in deep workings and haul it to surface, then transfer it to cars, and take it to a stamp-mill several miles away, crush the rock, and 'extract' the copper, which is then passed on to a smelter and reduced to ingot form, their product brings only 13c. per pound. These same ingots, rolled out in sheet form, bring five times the original price when retailed over the counter in hardware stores. By following their product through to the manufactured form, producers are hopeful that they may put their business on a more substantial basis.

MISSOURI

Joplin.—The Federal Water-Power Commission authorized the Dixie Power Co. to construct a dam and hydro-electric plant on the White river, near Cotter, Arkansas. The district is generally mineralized with zinc, lead, and manganese ores. It is expected that mining activity will be greatly stimulated by the development of hydro-electric power at a convenient point. In 1893 a chunk of zinc ore, weighing more than six tons, was taken from the Morning Star mine, near Yellville, and displayed at the World's Columbia Exposition at Chicago.

MONTANA

Basin.—Smelter returns on two carloads of silver ore, shipped from the Obelisk mine, show assays of 19 and 47 oz. of silver respectively. The gross value of the two cars was \$2600. J. H. McBarron is president of the company.

Butte.—The Anaconda Copper company produced 10,000,000 lb. of copper in February. Of this about 6,000,000 lb. was consumed by the company in its rod-mill. Production has been cut to the lowest possible point short of actual shut-down. Underground activity has been confined to but five mines. That its holdings of unsold copper were greater than those of other producing companies was evident from

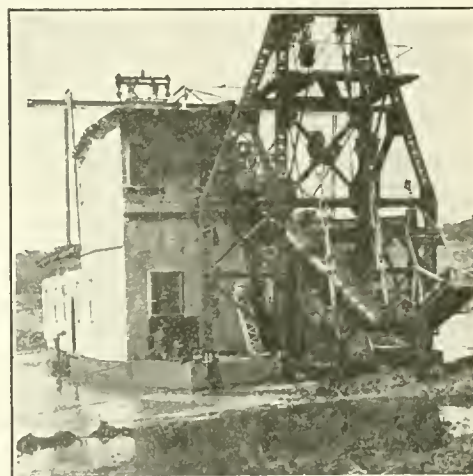
the fact that its participation in the export pool was more than 12% or close to 50,000,000 lb. of copper.

Saltese.—Harry M. Lancaster, superintendent of the St. Lawrence mine, reports the discovery of a deposit of chalcopryite ore averaging 30% copper. Development to date indicates that the find is the most important ever made in the district.

Sidlex.—Unwatering of the shaft of the Amazon-Dixie Co. has been completed, and an electric pump is being installed on the 1100-ft. level at a point 400 ft. below the main tunnel. According to Wesley Everett, manager, the shaft will be sunk another 400 ft. The Leslie property was recently acquired by the Amazon-Dixie.

NEVADA

Candelaria.—It is reported that the Candelaria Mines Co., which for the last two years has been re-opening the Holmes, Mount Diablo, Argentum, and Lucky Hill mines, is to start construction of a 150-ton mill on April 1. The company is



Gold-Dredge Near Murray, Idaho

controlled by the International Nickel Co. It is said the process to be used in the mill will be simple chlorination and cyanidation, with which an extraction of 98% will be obtained. The principal content of the ore is silver.

Caprite.—The Super Silica Corporation, formerly known as the Foster Mines, is building under direction of E. D. Foster, promoter and manager for the company, a plant for the production of air-floated silica. Mr. Foster says he plans to enlarge the plant now being built and to build another for fusing the silica for the manufacture of glassware, tile, pottery, brick, and similar articles. He says the National Chemical Co. of Los Angeles has contracted for the exclusive right to market the silica.

Divide.—A full face of \$30 to \$50 ore has been opened 275 ft. south-east of the cross-cut from the shaft on the 1000-ft. level of the Tonopah Divide, according to a statement issued by E. J. Erickson, secretary. This is thought to be the extension of the ore found on the 800-ft. level.—W. E. Edwards, a Goldfield engineer, and associates have taken over the Pay Divide, west of the Belcher, Belcher Extension, and Thompson, and will continue to the vein a cross-cut at a depth of 100 ft. The claims are less than one mile from the railroad and the new owners, having obtained \$7 assays over 5 to 6-ft. widths at the surface, will prospect for ore of slightly higher grade, which they can haul to the railroad for less than \$1 per ton.

Goldfield.—The Florence since the Schmidt-McCarthy management took charge in July 1919, has produced \$325,000 gross, of which the company has received \$75,000 in

royalties according to F. Sommer Schmidt, manager. This management has done 2633 ft. of development work at a cost of \$10.91 per foot. The fourteenth annual report of the Goldfield Consolidated Mines Co. gives cash on hand as \$292,451. The total cash value of the assets, "exclusive of the mine itself or any production that may in future come from it", is estimated at \$776,148. This includes the mortgage on the Dolly Varden and the stock of the Ash Peak. Machinery of the Aurora Consolidated, which recently transferred to the Consolidated all of its assets, and machinery at Goldfield owned by the Consolidated are being disposed of rapidly, but the report says equipment for treating the mill-tailing at Goldfield will be retained and kept available for use when the cost of labor and supplies is lower.

Klondyke.—The south drift in the foot-wall vein of the Maupin lease on the Original Klondyke has been driven 35 ft. in ore. The last two samples gave \$53 for a 2-ft. width and \$22 for a 4-ft. width. A 10-ft. drift to the north has been discontinued, as the best ore is being found to the south. The Keystone Divide has bought the Big Horn group and will develop it with machinery moved from Divide. The claims are one mile south-east of the Original Klondyke.

Manhattan.—Ore regarding which an official statement has not been made pending further development has been found 700 ft. from the shaft in the west cross-cut on the 800-ft. level of the White Caps. The vein that is the objective of the cross-cut is estimated to be 600 ft. beyond the face and the cross-cut will be continued to this vein.

Mina.—A shipment of ore from the Silver Bar mine, in the Marietta district, said to be worth \$1000 per ton, has been made, according to Henry Shepers, mine-superintendent. A second adit has been started, to cut the vein at a depth of 250 feet.

Pioche.—The Prince Consolidated has stopped shipping until sinking of the shaft is well under way. The Combined Metals has resumed shipments. Ore sent from the district last week totaled 1535 tons; 715 from the Virginia Louise, 365 from the Bristol, 205 from the Black Metals, 200 from the Combined Metals, and 50 from the Prince. The low tonnage is due to the decision of the Prince management to stop shipping for the present.

Stonewall Mountain.—The Yellow Tiger plans to raise through the sale of treasury stock an additional \$30,000, to be used in completing the Sterlag tunnel and notices of the plan have been sent to stockholders by Gordon M. Bettles, general manager.

Tonopah.—The Cash Boy, in an action filed at Carson, claims the apex of a vein opened at a depth of 1730 ft. at a point 40 ft. from the side-line of the Tonopah Extension. The orebody is said to be eight feet wide and to assay \$25. The court is asked to appoint a board of survey to judge regarding the ore that is taken from the vein.

Virginia City.—The production of the Consolidated Virginia last week was 661 tons of ore assaying \$24.08. The gross value was more than \$16,000. During the week the Mexican mill treated 572 tons of ore assaying \$23.67 from the Consolidated Virginia. These figures represent a further increase in the unusually large production that has been made since the opening of ore on the 2250-ft. level, from which 373 tons of \$35.84 ore was stoped during the week. The Mexican mill also treated 28 tons of \$16.05 ore from a drift in the Hardy vein on the 2000-ft. level of the Ophir. This drift was advanced 27 ft. last week and 38 tons of \$18 ore was saved in it. Track has been laid from the portal in the United Comstock tunnel and hauling with electric locomotives will be started in a few days.

West Divide.—The West Divide has let a contract for the sinking of a 100-ft. winze from the tunnel, or 150-ft., level. The winze will be sunk from the end of the first cross-cut to the vein, which entered the ore-shoot.

UTAH

Bingham.—A new company, to be known as the Bingham-Galena Mining Co., has been formed to take over the Silver Shield property, that of the United Bingham company, consisting of 22 acres, and the New York & Bingham Mining Co., consisting of about 27 acres. All of this property is in Upper Bingham, near the Utah Copper and United States Mining companies' holdings.

Coeke.—P. J. Fennell, manager for the Zuma Mining Co., states that the main winze, now at a depth of 800 ft., will be sunk to the 1200-ft. level. The shaft at the property is down to a depth of 500 ft. Heavier hoisting equipment, recently purchased from the Iron King property, will be installed. Development work has been resumed by the South Scranton Mining Co. A shaft is being sunk, which is now at a depth of 60 ft. During the past 15 years, this property has produced lead and zinc ore, but owing to the low prices of these metals, no shipments have been made during recent months. During February, the Grand Central Mining Co. shipped 19 cars of ore, from which a small profit was derived. About 40 men are now employed. Jack Mays, who recently took a contract to develop the Pinon Queen property, states that 393 ft. of drifting was done in the mine between January 26 and February 28, on the 800-ft. level. This property, in the eastern part of the district, is controlled by E. J. Raddatz and associates. It is well equipped. At the Iron King mine a drift is being driven to the south-west from the main shaft on the 1200-ft. level. Heretofore development work in that part of the mine has been on the 1565 and 1000-ft. levels.

One of the most cold-blooded murders in the history of Utah took place here on the night of March 9. Four Mexican bandits entered the Tintic Standard store and commanded John Manson, the proprietor, to throw up his hands. One of the bandits then forced Manson into a rear room where the safe is situated, thinking, no doubt, that the Tintic Standard company's payroll, to be distributed the following day, was in the safe. While one of the bandits was forcing Manson to open the safe, John Westerdahl, superintendent for the Tintic Standard, entered the store and was immediately fired upon by the three bandits. Westerdahl died instantly. L. P. Peterson, proprietor of a pool-hall next door, hearing the shots, entered the store and was fired upon, dying three hours later. The bandit who was covering Manson, in the rear room, fearing no doubt that a trick of some kind was intended, fired a shot at Manson, which lodged beneath the collar-bone. Manson is also manager for the North Standard Mining Co. A Mexican employee of the Tintic Standard, named Hernandez, hearing the shots, also started to enter the store and was fired upon, the shot entering his mouth and emerging at the back of his head. It is thought both Manson and Hernandez will recover. A posse was organized immediately, and assistance summoned from Salt Lake City and Provo, but no trace of the bandits has been found, although a number of suspects have been arrested. John Westerdahl was one of the most popular and best-liked mining men in this district, and his tragic death has shed deep gloom over the community. He was a native of Finland, 46 years of age, and had been in America 25 years. He entered the employ of the Tintic Standard in 1907 as a laborer, when the property was but a prospect. In addition to the advancement he achieved for himself, he is credited with having been a big factor in the notable success of the mine. He is survived by his wife and two daughters.

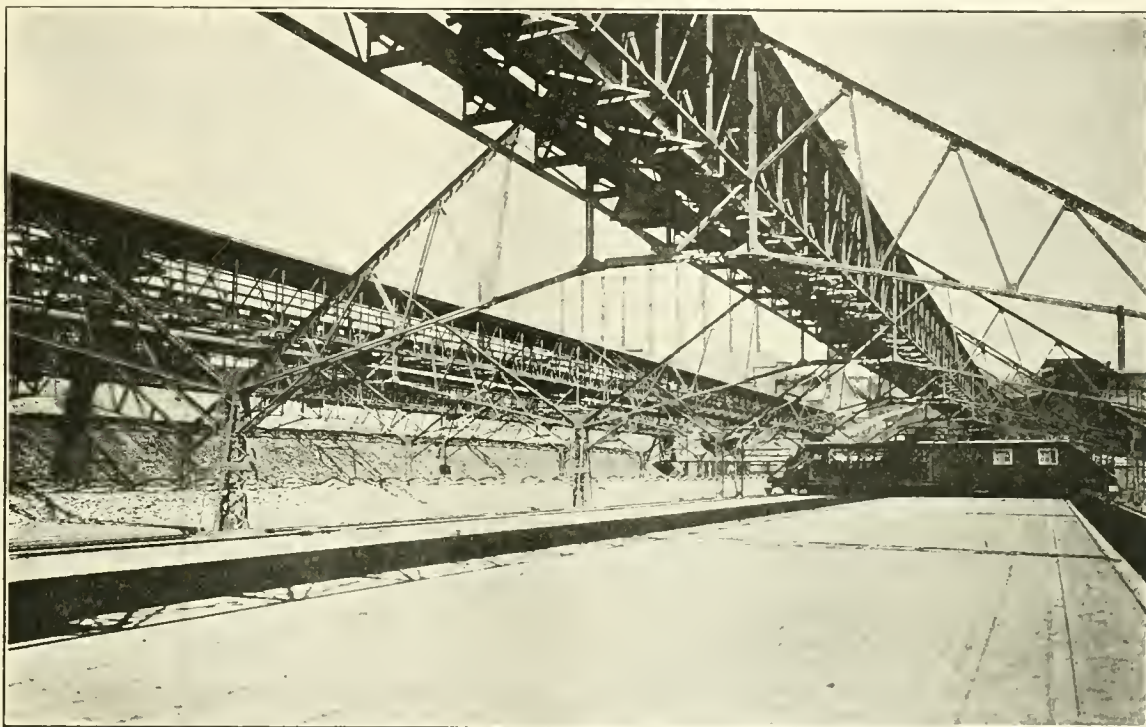
Park City.—The Park City King Mining Co. owns four claims at the head of Thayne canyon, adjoining the Iowa Copper and the Silver King Coalition companies. In the face of the tunnel, 600 ft. from the portal, there is a good showing of ore that will average \$20 per ton. Shipments of

ore from the Silver King Coalition property have been increased since the fire which destroyed the concentrating plant. It is expected that a new plant will be completed within five months. The O'Brien fissure is being explored through the M. L. M. and Blood cross-cuts on the 1100 and 1250-ft. levels. Recently the Central shaft, having a depth of 1450 ft., has been unwatered, which will permit of exploration work along the Mud and Cavanaugh fissures.

Salt Lake City.—Notices have been posted at the Murray plant of the American Smelting & Refining Co. and at the Midvale plant of the United States Smelting Co., announcing a further reduction in wages. On January 1, wages of craftsmen at the Murray plant were reduced 75c. and all other labor 50c., while the new scale, effective March 15, makes a further general reduction of 25c. per shift for all employees. At the Midvale plant, mechanics were reduced

Mines, Ltd., states that the company is pushing development work with excellent results, but that it has no intention of starting the mill or selling ore until there was a considerable improvement in the market prices of lead, silver, and zinc. Such clean ore as is being mined in development work is sacked pending favorable opportunities of selling at a profit. Last year the mine produced and marketed 2200 tons of lead-silver concentrate and 300 tons of clean ore. Besides this there is a considerable quantity of zinc concentrate that cannot be marketed in Canada, and excessive freight-rates prohibit shipment to the United States. A dividend of \$25,000 was declared for the last quarter of last year. About 40 men are employed on development work at the mine.

New Denver.—The Bosun, at New Denver, is maintaining development work during the present period of adverse metal prices.



Traveling Tripper for Distributing Ore at the Cananea Smelter

50c. per shift and all other labor 25c. per shift, effective March 15. The unsatisfactory condition of the market for lead necessitates this action, as many of the smaller mines have shut-down, while the larger ones have curtailed output considerably.

WASHINGTON

Valley.—The Double Eagle Mining Co. will resume operations at its property 12 miles south-west of here. Bids have been opened for the driving of 300 ft. of adit on the 700-ft. level, where a 485-ft. adit is already established. In addition there are two adits in the upper workings, one in 475 ft. and one 795 ft., where the vein has been cut. The Double Eagle ore is rich in silver; carbonate ore averages 70 oz. per ton with some lead and copper. The company shipped a carload of high-grade ore and has several tons ready for shipment.

BRITISH COLUMBIA

Greenwood.—The lease of the Providence mine to A. Morrison and W. McGillis having expired, the Providence Gold Mining Co. proposes to work the property itself, and, with that end in view, has ordered a compressor from St. Catharines, Ontario.

Nelson.—John B. White, president of the Silversmith

Quesnel.—A plant will be installed about two miles from here for the extraction of platinum and gold from black sand, if the plans of S. J. Marsh reach fruition. Mr. Marsh is the inventor of the method of extraction referred to and has been able to convince many practical mining men of the effectiveness of his patent.

Vancouver.—The 'Empress of Russia', which sailed for the Orient recently, carried a large consignment of refined copper from the Trail smelter.

CHILE

Santiago.—The Compañía Minera Disputada de las Condes has purchased the Compañía Minera Demasias, of Santiago, which operated neighboring copper deposits about 25 miles west of that city. The new company has a capital of 12,500,000 'paper' pesos, making it one of the largest copper mining enterprises owned by Chilean capitalists.

MEXICO

Monterrey.—In addition to the recent closing down of the large smelter here of the American Smelting & Refining Co. the plant of the company at Chihuahua has just suspended operations for an indefinite period. Several of the larger mining companies in the Santa Eulalia, Santa Barbara, and

other districts have also ceased mining on account of the low price of silver and lead. Among these are the Potosi Mining Co. of Santa Fe, and the Tacoloes Mining Co. of Santa Barbara. Another factor that is causing a decrease of mining activity is the railroad strike. While considerable freight is moving, there has been a big falling off in ore shipments from the different districts and camps, due to inability to get cars and the lack of train service. It is stated despite unfavorable conditions much is being done in the way of filing on claims, rehabilitating mine workings that have suffered from long disuse, and making preparations for resumption of productive operations when the price of metals becomes better and the railroad transportation situation improves.

Ines Paredes, of Mazatlan, State of Sinaloa, will install new machinery and equipment in the Buena Suerte mines in the Tamazula district, State of Durango, with a view to making that property a large producer of ore. It is stated—

Preparations are being made by Frederick Aguirre to develop a group of claims in the Topla district, State of Durango, which he recently acquired. These claims are situated close to mines that are producers of rich ore.

ONTARIO

Cobalt.—With the approach of open weather and the prospect of being able shortly to obtain adequate power, the question of the resumption of operations by the mines which closed down over the winter is receiving consideration. While the reduction of mining costs and the abundance of labor at a reduced rate of wages are favorable factors, on the other hand the depression in the price of silver and the prospective increase in mining taxation are adverse considerations. Any considerable increase in mining activity is hardly to be looked for at once. The proposed increase in the tax on mining profits continues to excite strong opposition, coming as it does at a most inopportune time, and at present it seems likely that the project will be abandoned.

The Oxford-Cobalt will resume sinking operations when power is available. The shaft will be put down from 180 to 350 ft. The vein which left the shaft at 40 ft. will be reached by cross-cutting.

Kirkland Lake.—The new mill of the Wright-Hargreaves will be started on May 1. A supply of power can now be had but not in the full quantity required and the management preferred to wait until a steady current sufficient for requirements could be obtained. The mill has a capacity of 180 tons daily.

Toronto.—Strong opposition is developing against the proposal of the Ontario Minister of Mines to reduce the amount of assessment work on mining claims. The Minister proposes to reduce the total to 200 days, with 40 days work required to be done every year for a period of five years. The former regulation has required 240 days, over a total of 39 months, and demanding that 30 days work be done during the first three months following staking. This provision ensured early activity, whereas to allow a full twelve months to elapse before the first work is believed likely to cause comparative inactivity in newly staked areas.

QUEBEC

Black Lake.—A protracted struggle for the control of the Black Lake Asbestos & Chrome Co., Ltd., was terminated at the annual meeting on March 2 by the election of a board of directors representing the Jacobs interests. The new directors are Jacob A. Jacobs, W. G. Ross, and J. W. Cook of Montreal; and Maurice Amado and Leon Schinasi of New York. The annual report showed a total income of \$195,668, as against \$179,833 for the previous year, and a surplus of \$1510 after paying all expenses, interest, and allowance for depreciation.

PERSONAL

The Editor invites members of the profession to send particulars of their work and appointments. The information is interesting to our readers.

Etienne A. Ritter is at Oatman, Arizona.

Bulkeley Wells has returned to New York from Denver.

Percy R. Middleton has gone to Anyox, British Columbia.

Donald H. Fairchild, of Denver, was at Chicago last week.

G. A. Overstrom is expected here on his return from Korea.

Pollon & Poirier have moved from 63 Wall St. to 42 Broadway, New York.

J. M. Sully, general manager for the Chino Copper Co., was in San Francisco recently.

Charles S. Withereff has opened an office as metallurgical engineer at 150 Nassau St., New York.

William T. MacDonald has become mill superintendent for the Moctezuma Copper Co., at Naco, Sonora, Mexico.

G. G. Brown and H. E. Utley announce their partnership as mechanical and structural engineers, with offices in the Monadnock Bldg., San Francisco.

Charles Hayden, vice-president of the Utah Copper, Chino Copper, and Ray Consolidated Copper companies, has returned to New York after a vacation at Palm Beach, Florida.

A. W. Newberry cables from Colon that he will sail from that point on March 15 for New York. He has been on the west coast of Nicaragua on examination work since last November.

Obituary

Jesse Knight, capitalist and mining man, died at his home at Provo, Utah, on March 14. He was 75 years old. Jesse Knight is well known as the man who has done most toward the development of the Tintic mining district in Utah.

Dwight B. Huntley, who died at his home in Oakland on March 7, was active in mining for more than the time of a generation. Born at Grass Valley, he came to San Francisco to become a student in the Boys' High School and entered the University of California in 1870, but trouble with his eyes forced him to drop out for a year and so it was with the class of '75 that he was graduated. Soon afterward he went to Lodi, Nevada, as assayer and metallurgist for a company headed by W. H. Raymond, who opened the mines at that camp and erected a lead smelter to treat the ores. In 1880 he went to Tombstone, Arizona, to be assayer for the Girard Mining Co.; next in a like capacity to the Total Wreck mine; and then he became superintendent of the mill of the Grand Central Co. From Tombstone he went to New Mexico as manager of the Carlisle mine and so continued until that property was taken over by an English company. Later he was manager of a gold mine in Colombia, South America, but soon came back to California. In 1893, at the time of the silver slump, he was manager of the Morning mine, at Mullan in the Coeur d'Alene, and was in that district during its years of turmoil. Next he was at a silver-lead mine in the San Juan country, Colorado; he became manager of the Tomboy, and succeeded Capt. Plummer as manager of the De Lamar company in Idaho, but resigned to become consulting engineer for the Matabele Gold Reef & Estates, Ltd., in Rhodesia. He returned from Africa in 1904 and for five or six years, like a number of others, visited many mining districts in the hope of finding a property suitable for himself. For ten years past he has lived with his family in Oakland, busy with his own interests. He was a close student, a hard worker, and a man of exemplary life and unblemished character. J. R. F.

THE METAL MARKET



METAL PRICES

San Francisco, March 15

Aluminum-dust, cents per pound.....	75
Antimony, cents per pound.....	6.50
Copper, electrolytic, cents per pound.....	13
Lead, pig, cents per pound.....	4.25—5.25
Platinum, pure, per ounce.....	\$75
Platinum, 10% iridium, per ounce.....	\$105
Quicksilver, per flask of 75 lb.....	\$45
Spelter, cents per pound.....	8
Zinc-dust, cents per pound.....	12.50—15.00

EASTERN METAL MARKET

(By wire from New York)

March 14.—Copper is quiet and easy. Lead is quiet and firm. Zinc is inactive but steady.

SILVER

Below are given official or ticker quotations for silver in the open market as distinguished from the fixed price obtainable for metal produced, smelted, and refined exclusively within the United States. Under the terms of the Pittman Act such silver will be purchased by the United States Mint at \$1 per ounce, subject to certain small charges which vary slightly but amount to approximately three-eighths of one cent. The equivalent of dollar silver (1000 fine) in British currency is 46.65 pence per ounce (925 fine), calculated at the normal rate of exchange.

Date	New York cents	London pence	Average week ending Cents	Pence
Mch. 8.....	53.75	31.25	Jan. 31.....	64.52
" 9.....	54.12	31.62	Feb. 7.....	61.66
" 10.....	54.50	31.62	" 14.....	61.70
" 11.....	54.37	31.50	" 21.....	58.81
" 12.....	56.50	32.75	" 28.....	55.67
" 13 Sunday.....			Mch. 7.....	54.18
" 14.....	57.50	33.50	" 14.....	55.12

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.	101.12	132.77	65.95	July	108.36	92.04	....
Feb.	101.12	131.27	59.55	Aug.	111.35	96.23	....
Mch.	101.12	125.70	....	Sept.	113.92	93.66	....
Apr.	101.12	119.56	....	Oct.	119.10	83.48	....
May	107.23	102.69	....	Nov.	127.57	77.73	....
June	110.50	90.84	....	Dec.	131.92	64.78	....

COPPER

Prices of electrolytic, in cents per pound.

Date	Average week ending
Mch. 8.....	12.25
" 9.....	12.25
" 10.....	12.12
" 11.....	12.12
" 12.....	12.12
" 13 Sunday.....	
" 14.....	12.12

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.	20.43	19.25	12.94	July	20.82	19.00	....
Feb.	17.34	19.05	12.84	Aug.	22.51	19.00	....
Mch.	15.05	18.49	....	Sept.	22.10	18.75	....
Apr.	15.23	19.23	....	Oct.	21.66	16.59	....
May	15.91	19.05	....	Nov.	20.45	14.63	....
June	17.53	19.00	....	Dec.	18.55	13.18	....

LEAD

Lead is quoted in cents per pound, New York delivery.

Date	Average week ending
Mch. 8.....	4.15
" 9.....	4.10
" 10.....	4.00
" 11.....	4.00
" 12.....	4.00
" 13 Sunday.....	
" 14.....	4.00

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.	5.60	8.65	4.96	July	5.53	8.63	....
Feb.	5.13	8.88	4.54	Aug.	5.78	9.63	....
Mch.	5.24	9.22	....	Sept.	6.02	8.08	....
Apr.	5.05	8.78	....	Oct.	6.40	7.28	....
May	5.04	8.55	....	Nov.	6.76	6.37	....
June	5.32	8.43	....	Dec.	7.12	4.76	....

TIN

Prices in New York, in cents per pound

	1919	1920	1921		1919	1920	1921
Jan.	71.50	62.74	35.91	July	70.11	49.29	....
Feb.	72.44	59.87	32.16	Aug.	62.20	47.60	....
Mch.	72.50	61.92	....	Sept.	55.79	44.43	....
Apr.	72.50	62.17	....	Oct.	54.82	40.47	....
May	72.50	54.99	....	Nov.	54.17	36.97	....
June	71.83	48.33	....	Dec.	54.94	34.12	....

ZINC

Zinc is quoted as spelter, standard Western brands, New York delivery, in cents per pound.

Date	Average week ending
Mch. 8.....	5.20
" 9.....	5.20
" 10.....	5.25
" 11.....	5.25
" 12.....	5.30
" 13 Sunday.....	
" 14.....	5.30

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.	7.44	9.56	5.86	July	7.78	8.18	....
Feb.	6.71	9.15	5.34	Aug.	7.81	8.31	....
Mch.	6.53	8.93	....	Sept.	7.57	7.84	....
Apr.	6.49	8.76	....	Oct.	7.82	7.50	....
May	6.43	8.07	....	Nov.	8.12	0.78	....
June	6.91	7.92	....	Dec.	8.69	6.03	....

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, according to quantity. Prices, in dollars per flask of 75 pounds.

Date	Average week ending
Feb. 15.....	50.00
" 22.....	47.50

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.	103.75	89.00	50.00	July	100.00	88.00	....
Feb.	90.00	81.00	48.75	Aug.	103.00	85.00	....
Mch.	72.80	87.00	....	Sept.	102.00	75.00	....
Apr.	73.12	100.00	....	Oct.	86.00	71.00	....
May	84.80	87.00	....	Nov.	78.00	56.00	....
June	94.40	85.00	....	Dec.	95.00	52.50	....

FINANCING FOREIGN TRADE

It certainly will be better for everybody concerned—and everybody in this country is concerned—if the theory of full production under which we were operating a year ago, is the right one. When our factories are running at capacity, when farmers are bending every effort to produce record crops, at such times there is employment for everyone, money is plentiful—in short, we are enjoying good times. A year ago we could not produce things fast enough to meet the demand; now we cannot sell things fast enough to take care of a greatly diminished production.

Naturally, when a man cannot sell a thing in one place, he turns to another and tries to sell it there. In the case of the United States just now, the natural thing is to turn to the rest of the world and see whether we cannot sell our surplus products there. It has been tried. It cannot be done. Why? Because the exchange of almost every foreign country is so depreciated that the people will not buy from America unless absolutely necessary and then they take only what they cannot get anywhere else. Moreover, we have extended to these countries all the short-term credit that banks of this country can handle, says John McHugh, of the Foreign Trade Financing Corporation, in a recent statement.

How, then, are we to get back to full production and 'good times'? It can be done only by extending to foreign buyers long-term credits, allowing them time to put to work the raw material and machinery they buy and letting these earn the money to pay us. It is something we have never done before, but we must do it now. We have reached a point where we produce more than we can consume; the surplus must be exported. Every sale in a foreign market means a day's work for American labor.

It is to meet this important need that the Foreign Trade Financing Corporation is being formed under the Edge Act. This Corporation, the largest so far conceived under provisions of that law, will provide the long-term credits foreign buyers need to enable them to buy American goods, thereby keeping factory wheels, plows, railroads, and steamships of this country busy.

The Foreign Trade Financing Corporation is now being formed under the guidance of its Committee on Organization, on which are represented all branches of American industry. It is intended to make this corporation as representative as possible by including in its personnel men from all sections of the country and from every line of industry; in other words, the Corporation will be made up of American farmers, business men, and bankers.

The Corporation will aid the foreign buyer to purchase American goods and at the same time relieve the American seller of carrying the burden of slow payments. For example, suppose a merchant in Spain desired to purchase a bill of goods in the United States. At the office of the Foreign Trade Financing Corporation in his country he would apply for a loan, stating what he could put up as collateral; this would be investigated, not only by the Foreign Trade Financing Corporation, but also by the Federal Reserve Board. If the security proved satisfactory, credit would be extended and placed to his account in America. Thus enabled to purchase American products and pay the shipper on delivery, he receives and disposes of the goods, while the Foreign Trade Financing Corporation charges him interest for the use of the money until the loan is paid.

MONEY AND EXCHANGE

Foreign quotations on March 15 are as follows:

Sterling dollars:	Cable	3.91 3/4
	Demand	3.92 1/4
Francs, cents:	Cable	6.98
	Demand	7.00
Lire cents:	Demand	3.75
Marks, cents:		1.64

Eastern Metal Market

New York, March 9

The only market in which there is any distinct improvement is lead. In the others prices are lower.

Conditions in the copper market are no better and prices are lower.

Values of tin have again declined and buying is light.

Demand for lead is better, which, combined with curtailed production, has advanced prices.

There has been a slight improvement in demand and prices for zinc.

IRON AND STEEL

March promises as yet no more business than February, which made a record for dullness. Failing to see signs of active buying interest, mills have entered the small amounts of current business at levels above the minimum of late extreme quotations. For further betterment the steel-makers regard as essential the reduction of railroad wages, and in that way of freight-charges. Buyers, on the other hand, are divided into two camps. One is looking for wage and price revisions by the United States Steel Corporation as a means of establishing confidence in market stability; the other is urging a maintenance of the corporation stand until stocks are near a thorough liquidation and price guarantees on manufactured goods are no longer involved. The latter appears to have a few weeks yet in which it may turn around.

A further restriction in corporation operations has taken place in the Chicago territory, but in Pittsburgh and the Valleys no material change has occurred. It is doubtful if the independent steel mills are operating at as high as 20% of capacity.

The February production of steel ingots, according to the records of the American Iron and Steel Institute, suggests a total for the country of 2,055,306 tons for February, or a daily average of 55,638 tons, against 103,533 tons per day for January.

COPPER

Conditions remain unchanged so far as any improvement is concerned, demand being no better. As a result of competition for such light business as is offered prices are lower. Electrolytic is quoted at 12.37½c., delivered, or 12.25c., New York, for early delivery, with forward positions ranging up to 12.75c. Lake copper is also lower at 12.75c. for early delivery. The situation in Europe is such that there is not much chance for heavy buying from that source for the present.

Copper exports in 1920 were 246,083 gross tons, compared with 195,607 tons in 1919 and 413,500 tons in 1913 when Germany was an abnormal buyer.

TIN

Prices, both in London and here, have further declined until new low levels are recorded. This is explained by one authority by the wide open market in the Far East which was announced a week ago. London values are down £8 to £13 per ton from those of a week ago, spot Straits yesterday being quoted at £160, against £173 a week ago, and spot standard at £150 15s., against £158 last week. In the local market spot Straits was quoted yesterday at 28c., New York, against 30c. a week ago. The market has been generally quiet here with a fair amount of trading between dealers, amounting to about 150 tons per day, mostly futures. The spot market has been inactive and slow, as in the past few weeks. A few consumers have been buyers, but the quantity involved has been very light. Arrivals thus far this month have been 30 tons with 1550 tons reported afloat.

LEAD

A much stronger tone is discernible in this market. This is due to the strong position of independent producers, who have curtailed output. It is hard to obtain future shipment from this source or even offers for prompt. In fact it is not possible to buy at 4c. in the outside market, where the asking price is 4.20 to 4.25c., New York. This has not been established by sales on any large scale. The business going is being taken by the leading interest, which quotes 4c., New York and St. Louis.

ZINC

A little improvement is reported, but it is not important. Prices have stiffened somewhat after remaining at 4.75c., St. Louis, for a long period. This is due to a little better inquiry for early delivery, as well as the situation in Germany, which indicates the probability of less zinc from that source, at least unless an export tax of 12½% is paid. This factor may be more sentimental than otherwise. Prime Western for early delivery is quoted at 4.80 to 4.85c., St. Louis, or 5.30 to 5.35c., New York, with the imported metal held at 5.15 to 5.20c., seaboard.

ANTIMONY

Wholesale lots for early delivery are unchanged at 5.20c., duty paid, New York, with the market inactive.

ALUMINUM

The leading producer continues to quote virgin metal, 98 to 99% pure, at 28c. f.o.b. plant, for wholesale lots for early delivery, while the same grade from other sellers is held at 23.25 to 24.25c., New York.

ORES

Tungsten: Demand is exceedingly light and business is at a standstill, with quotations unchanged and nominal, ranging from \$2.60 to \$3.75 per unit, depending on the grade, quantity, and delivery.

Ferro-tungsten is quiet at 58c. per pound of contained tungsten in lump form, guaranteed.

Molybdenum: There are no developments and no market. Quotations are nominal at 55 to 60c. per pound of MoS₂ in regular concentrate.

Manganese: There is no interest from consumers and quotations are nominally lower at 30 to 35c. per unit, seaboard, for high-grade foreign ore.

Manganese-Iron Alloys: Demand for both ferro-manganese and spiegeleisen is light. The former is quoted at \$95 to \$100, delivered, for the domestic alloy, with the British alloy unchanged at \$100, seaboard. Spiegeleisen is inactive at \$35, furnace, but this can be and has been shaded. Imports of ferro-manganese in January were 1107 tons, which is the smallest in some months and contrasts with 4938 tons per month in 1920. The February output of ferro-manganese from American blast-furnaces, according to 'The Iron Age', was 17,447 gross tons, comparing with 19,686 tons in January and 23,557 tons per month in 1920. The spiegel-eisen output in February was 11,566 tons, as against 2542 tons in January.

There seems to be no prospect of immediate improvement in silver. Late advices from London show money cheaper in Shanghai. To aggravate the situation, some 5,000,000 additional ounces are on their way to Shanghai. What little demand there is from India is being met from China. Heavy consignments to India from China, America, and Great Britain have depressed quotations for forward delivery in the bazaars, and accentuated the weakness of Indian sterling exchange.



T. A. RICKARD, Editor

WE learn that the great British shipping octopus, the Royal Mail Steam Packet Company, whose subsidiary, the Pacific Steam Navigation Company, controls a large proportion of the passenger and freight traffic between New York and the West Coast of South America, is to establish a direct service of steamers between Great Britain and Vancouver, through the Panama Canal. The new service will be started some time in May. This will be an interesting item of news to travelers, especially mining engineers.

THE men who have to feed at the mine boarding-house often register periodic 'kicks' about the grub. An engineer, in commenting on a paper recently discussed before the Institution of Mining and Metallurgy, mentioned an instance in which the bread supplied to a mine mess was found to contain about 33% of non-flour starch, which had been added in the form of a mash prepared from undersized potatoes bought cheaply by the baker. The presence of the substitute for flour was detected when an estimation was made for nitrogen content of the bread. The baker was warned, and supplied all-flour bread until he learned how the mine official had detected the adulteration. Then he returned to the starch mixture, adding a proportion of bean-mash to bring up the nitrogen content. He was again foiled, because the analyst possessed a microscope. The standardization of specifications for material supplied to mines is an important subject, but don't let us forget the 'eats'.

THE cause and control of lead poisoning is the subject of an interesting and instructive article in this issue. The author, Mr. Wilbert S. Slemmons, who is bacteriologist for the Carnation Milk Company of Chicago and a graduate of the University of Wisconsin, has made an intensive study of the question, which he now discusses from the technical viewpoint and in a systematic manner. The Industrial Commission of Wisconsin has issued a new bulletin on the subject of sanitation in lead plants. Personal and general cleanliness and the strict observance of the elements of personal hygiene are primary essentials. The drinking of alcoholic liquors at any time is discouraged, beards and mustaches should be shaved, and the chewing of tobacco while at work is forbidden. It is highly advisable that workers in lead plants should drink plenty of good milk, which is preferable from every standpoint to treatment with potassium iodide. The

vitamines and mineral salts in natural milk have been proved to provide the best insurance against lead poisoning. Matters affecting the good health of those engaged in the metallurgical industry are of prime importance, so we are glad to print Mr. Slemmons' article, commending it to the particular attention of smelter managers and of the medical staff in their local hospitals.

THE metal miner has one consolation seldom realized: he is free from the fear of competition from synthetic products, for he deals with elements and not with compounds. Our confrères in the field of industrial chemistry are meeting disappointment in several directions. The prospect of the commercial manufacture of synthetic caoutchouc is postponed almost indefinitely on account of the reduction in the market price of plantation rubber. After intensive research and costly experimentation, synthetic camphor was produced in quantity in the United States, but competition is realized to be impossible against the cheaply-produced natural product. The camphor industry in the East, doubtless given a fillip by the fact that a synthetic product could be made, has increased by leaps and bounds, the exports from one district in China alone having risen from 20 tons in 1918 to 130 tons in 1919. Synthetic indigo will meet with severe competition in the near future and as soon as the new Assam indigo industry, previously worked in a slipshod manner, is under efficient control and has adopted modern methods of intensive cultivation of the indigo plants. However, we are of the opinion that no really scientific work is wasted, even if the immediate commercial result is inappreciable. The American chemical industry will profit ultimately by the advances made, for there is nothing more inspiring to the scientific mind than achievement for achievement's sake.

WE have often heard of 'gold' that could readily be caught by panning, and that eluded the collecting lead used in the ordinary fire-assay; but we confess that never have we known of gold that could be amalgamated, retorted, and exchanged for real money at the Mint, but that still would fail to reveal its presence in an assay of the ore containing it. This phenomenon is recorded on the authority of Mr. Ben. R. Koering, metallurgist for the Lynn Big Six Mining Company, whose property is near Carlin, Nevada. The erection of a new

milling plant recently completed, is clear evidence of the conviction of the owners that their ore contains the gold, in spite of the fact that assays by the usual fire method show only 20 cents per ton. Mr. Koering attributes the mysterious disappearance of the gold from his "spirit" ore to the presence of gallium. He believes the gallium, which is one of the rare elements only recently subjected to careful study, combines with the gold and perhaps some other metals in the ore to form a highly volatile alloy that escapes from the crucible during the fire assay. A peculiarity of gallium is its low melting point, it becomes liquid at 30 C., which is below the normal temperature of the human body. It is to be hoped that Mr. Koering's theory will be confirmed and, moreover, that the gallium is removed or at least rendered innocuous before the bullion-making stage in the new process is reached, otherwise the same "spirit" that pervades the assay-crucible may extend its influence to the bullion-mold.

THE economic possibility of removing oxygen from cyanide solutions by chemical means has doubtless occurred to many engineers. Mr. H. A. White, to whom the profession is indebted for the results of much valuable research in the metallurgy of gold ores, has recently concluded an investigation; and an abstract of his paper on the subject appears on another page of this issue. The results are chiefly of interest in that they are entirely negative, it having been shown that, with all the reagents used, the cost would far exceed the benefit resulting. The conclusion is reached that a mechanical method for the de-aëration of cyanide solutions, such as by the Crowe process, is the only practicable one available at the present time. Such an investigation, if conducted in a scientific manner, is worth while. Even though the results are negative, they indicate the suitability and economic efficiency of present practice, and remove doubts as to the possibility of a rival scheme being introduced in the near future. In many instances operators will hesitate to adopt an obvious improvement for fear that some unpatentable modification may be available later, by which the same result may be achieved with little or no initial outlay. The publication of Mr. White's investigations, though stimulating to research in general, will also prevent the overlapping of experimental effort in this direction.

POULTNEY BIGELOW addressed the Commonwealth Club last week on the eve of his departure from San Francisco to Japan, and delighted a large audience. He told a story about a man in a motor-car on a New England road who encountered a herd of swine that rushed in front of his car, and then behind the car, and then in front again, until in his bewilderment the man turned to an old farmer sitting on a porch of the near-by house and to whom the pigs appeared to belong. The old fellow spoke hoarsely; he explained that since he had lost his voice he had adopted the practice of tapping on wood as a signal to the pigs that their feed was ready, but the "damned woodpeckers" spoiled his system and

drove the pigs crazy. That, said Mr. Bigelow, was like the newspapers, which drove the people crazy with their false alarms. One read this or that silly story only to find it baseless. One might just as well cease reading the daily papers and take down a good book like Gibbon's 'Decline and Fall'. It would be as up to date and much more informing. Mr. Bigelow referred to the fact that he and his New England friends had proposed recently to celebrate the 300th anniversary of the landing of their forefathers, but the Irish had objected because they were "only Americans". People quarrel with their neighbors because they are handy. We scrap with England because the English are near and because we cannot speak French. We object to the Japanese, but admit the "fleabitten" peoples of Eastern Europe, the Czecho-Slovaks and Armenians. Mr. Bigelow had been in Japan, and had been kindly treated by the Japanese, in whom he found much to like and to admire. He hoped we would not be rushed into war with them, as with Spain, by the reckless lying of the yellow press. People read the slush in their morning paper and believed it because it was in print, not realizing the ignorance of the fellows who wrote it. Few people have an opinion of their own; like the pigs they are herded by the woodpeckers. We wish Mr. Bigelow a pleasant voyage.

COMMUNISM Successfully Applied to Coal Mining might be an appropriate title for a report by Mr. J. J. Bourquin recently published by the Bureau of Mines. He describes the operation of the Keely mine at Dugger, Indiana, where for eight years the mining has been done by a co-operative organization of miners, the entire enterprise being managed successfully by two small committees, one on finance, the other on policy, selected by, and from among, the men that actually mine the coal. The mine was originally equipped and operated and is still owned by the Stockton Coal Company; the status of the present association is simply that of lessee. The organization is not a corporation but a partnership in which each individual member is liable for the acts of the firm. The proprietors, directors, or miners, whichever one chooses to call them, are paid twice monthly by dividing the net profit on the basis of the amount of coal each individual has mined and loaded. A miner who loses a day on account of sickness is excused from the pro-rated operating expense for one day; but if the absence is for any other cause, he bears the expense as though he had worked. This seems fair, and it certainly should effectually exclude a man who is not inclined to work steadily. The operating expense consists of (1) the salary of the superintendent, who is paid an amount equal to the average earnings of the ten miners receiving the largest share during the period; (2) the wages of the men employed by the day, who are paid according to the prevailing scale in the district and who do all the work other than actual mining; (3) the cost of supplies (except coal for use under the boilers in the power-house), the total of which is divided equally among the partners and deducted from the net tonnage of each; (4) sales commissions; (5) royalty fees; and (6) miscellaneous items. Deductions are also

made to permit the accumulation of a fund with which to purchase the property from the owners, and for a separate reserve-fund to be available in an emergency. When any partner withdraws, his share of the purchase-fund is returned to him; and one of the day workers, among whom there are always a number of men eager to become miners, is selected to take his place. Only union men are employed in and around the mine, and on occasions when the hired employees have gone on strike the partners have also laid down their tools pending a settlement with the executive board of the miners' union. Mr. Bourquin confesses that at first many difficulties arose: the less energetic and ambitious workers naturally were inclined to let their associates produce most of the coal, while they themselves wanted an equal share in the profit. However, changes were made in the method of organization and in the personnel, with the result that smooth operation, with earnings to the miners approximately 50% higher than those paid for mining the same quantity of coal in neighboring mines, has prevailed for a number of years. To the casual reader some of this may smack suspiciously of the soviet; but a second thought reveals little of comfort or encouragement to the advocates of that system. In fact, we doubt whether the co-operative scheme as outlined could ever have been successfully established had the enterprise been larger than it is, or had conditions been less nearly ideal. There are but 37 partners digging coal, 20 other men are employed, and the production is only 300 tons per day; the coal is mined without machines and the entire output is sold by contract to the railroad companies.

The Transactions of the Institute

Criticisms of the publications of the Institute have been concentrated chiefly on the magazine issued monthly, but it has been suggested also that the Transactions are excessive in bulk and cost. Volume LXIII reached us recently and we examined it critically, with results confirming the supposition that too much is printed and too little is edited. The latest volume of Transactions has 966 pages. Of these, the first 172 pages and 20 more later in the volume are papers contributed by permission of the Director of the U. S. Geological Survey. An aggregate contribution of 84 pages comes from the U. S. Bureau of Mines and 34 pages from various State Geological Surveys. Thus 310 pages comes from official bureaus of one kind or another. It is not ungracious to surmise that many of these papers were sent to the Institute for publication in order to conserve the funds of the Federal and State bureaus, and also in the expectation that their publication by the Institute in pamphlet form, cheaply, would be more prompt than at home. Examining the other papers in Volume LXIII, we find nine, aggregating 103 pages, that we would consider unworthy of publication; and 91 more pages that we would label 'doubtful'. We cannot see why the Transactions should be cluttered with papers on the mud volcanoes of Colombia, the titaniferous iron sands of New Zealand, the recovery of sulphur from illuminating gas, the correlation of the

Huronian formations, the testing of coals for by-product coking, the effect of sulphur in coal used in the ceramic industries, and other subjects so remotely, if at all, related to the technical operations in which our members are interested. We do not say that papers on such subjects have no value; but, if they have value, why are they not contributed to the publications of technical societies to which they belong? There was a time when the origin of ores and the structure of ore deposits engaged the keen interest of mining engineers; when other means of publishing discussions on the subject were lacking; and when, moreover, the secretary of the Institute was himself a geologist and writer of the first rank. Then it was fit and proper that many papers on the subject should find their way into the Transactions, but now other mediums exist for publishing such material, notably 'Economic Geology', which was started for that very purpose. The Federal Geological Survey and the Bureau of Mines each have ample funds for publishing their reports, and they distribute a large quantity in such a way as to reach the public that wants them; why should they use the Institute so freely for this purpose? This is said in no spirit of unkindness to the bureaus at Washington, but as a suggestion for diminishing the excessive cost of the publications issued by the Institute. In Volume LXIII we find only 122 pages of discussion; this is entirely disproportionate to the 844 pages of original papers; it were better if the ratio were reversed. There is far too much half-baked stuff being printed, without the criticism that is needed to correct erroneous statements and opinions, or to emphasize those that are true and just. Volume LXIII is insufficiently edited. Even a cursory inspection discloses opening sentences or paragraphs in many of the papers that are lamentable in their phrasing, indicating the most perfunctory kind of revision. We conclude that Volume LXIII could have been reduced from 966 to 550 pages without loss to the members of the Institute.

Oxy-Acetylene Welding and Cutting

The generosity of the Anaconda Copper Mining Company in encouraging the dissemination of valuable technical information is proverbial. This week we publish an article by the superintendent of the welding-shop at the Anaconda reduction works, Mr. Thomas W. Cunningham, on oxy-acetylene welding and cutting, which indicates the importance attained by this comparatively new branch of engineering work, and from which one may presage further possibilities in the direction of increased application. The economy and the general improvements resulting from the adoption of the oxy-acetylene processes have been extraordinary, and the uses of the torch in mining and metallurgical work will be apparent after a perusal of Mr. Cunningham's article. The immensity of some of the tasks undertaken and the importance of the work achieved are shown by the fact that one job consisted of over twelve miles of welding. The saving of labor and time, the latter a vital consideration in mining and metallurgical plants that op-

erate on a 24-hour basis, is such that the oxy-acetylene equipment is now considered an essential adjunct to a modern repair shop; in many cases it decides the question of profit or loss on a week's operation, during which a breakdown has occurred.

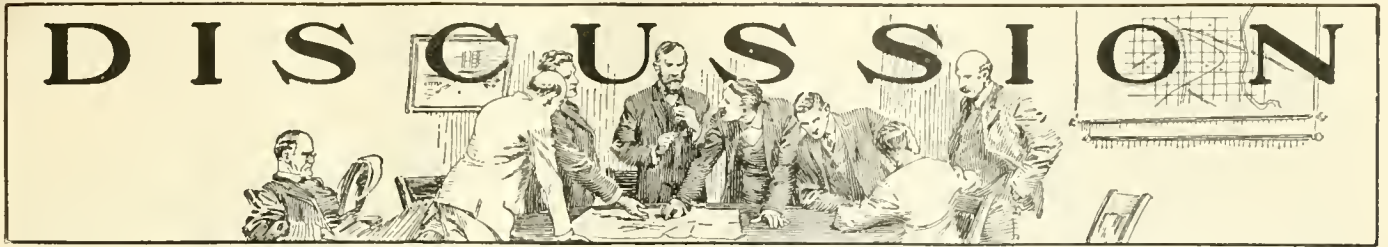
The welding and the cutting of metals by the oxy-acetylene torch are two distinct operations. Welding is a mechanical process, depending on temperature and fusion to effect junction; cutting, on the other hand, is a chemical process, depending to a small extent on temperature, but mainly on the oxidizing erosion of the heated metal by the action of a stream of oxygen. Oxy-acetylene welding results in junction without the use of pressure or impact. In this respect it differs from forge-welding. Moreover, metal of the same constitution as that of the parts to be welded is used as a connective agent; so that oxy-acetylene welding differs from brazing or soldering in that solder is not used; the joint results in a positive union; fluxes are needed but rarely; they are generally unnecessary. The gases utilized—acetylene and oxygen—are by far the most suitable for welding purposes, the former because of its high carbon content, and the latter because of the fact that efficient combustion is only practicable when it is present. Hydrogen or coal-gas is now seldom used; for it is found that with an adjusted combination of acetylene and oxygen a 'neutral' flame can be produced with a welding temperature of over 6000°F. The acetylene gas is usually prepared, as required, by the action of water on calcium carbide in appropriate generators; in many instances it has been found advantageous to utilize, as a means of storage, a suitable inert substance that has been steeped in acetone—a liquid that has the property of absorbing about twenty times its own weight of acetylene at normal temperature and pressure. At super-normal pressures a correspondingly increased amount of gas can be stored in a small volume, to be given off as required; at about 15 atmospheres a storage cylinder will hold about 150 times its own volume of the gas. The acetylene should be washed and dried before use if the most efficient results are desired.

The oxygen necessary is usually obtained by the decomposition (electrolysis) of water by electricity. It is stored and transported in steel cylinders, in which it is compressed to about 120 atmospheres. This method of preparation is recommended on account of the purity of the product that results—an important factor of success in welding or cutting operations. Engineers in charge of mining and metallurgical plants in isolated localities sometimes hesitate to recommend the purchase of oxy-acetylene equipment because of the difficulty in obtaining oxygen locally. It is now recognized that an electrolysis machine for the manufacture of oxygen from water must be considered as an item of standard equipment in any modern plant; for it is only when oxygen and acetylene are available in quantity at a moment's notice that the value of the process becomes apparent. Once the installation has been made, a thousand and one welding and cutting jobs will require attention, an immense saving in time and labor will result, the entire plant can be kept

in a fit state of repair, and the members of the staff can feel confident in their ability to meet almost any imaginable emergency that may result from a mechanical breakdown. Oxy-acetylene welding is applicable to practically all types of metal, including the majority of the special steels in use, cast-iron, brass, and lead. The peculiar characteristics of copper and aluminum must be taken into account if either of these metals is to be welded; if this be done, little trouble will be experienced by the welder.

Not only in operation but also in preliminary estimation should the possibility of the adoption of the oxy-acetylene processes be considered. We call to mind an engineer's report on a large project in South America, with particular reference to a supply of water from the mountains to the property, a distance of over 100 miles. All classes of steel and wood pipe were considered, specifications were drawn up, and a report was presented favoring the construction of a particular type of steel pipe. Soon afterward it was realized that the possibility of adopting an oxy-acetylene welded pipe had been overlooked. The engineer then made inquiries and found that an immense length of welded-steel pipe had been laid down to meet the severe conditions obtaining in New York City, and that the outcome had been successful, both as regards first cost and subsequent operation. Fresh specifications were prepared, the result being that the oxy-acetylene welded pipe was unhesitatingly recommended for the South American project, the figures showing that the saving in first cost alone would amount to over \$50,000; and an additional advantage was seen in the fact that all the welding equipment would be available for use before and when the property had reached the producing stage.

As mentioned earlier in these remarks, cutting with oxy-acetylene gas is almost entirely the result of chemical action. The mixed flame from a special type of burner raises the temperature of the metal to be cut to a red heat; a stream of oxygen, playing on this, then causes a rapid erosive oxidation of the metal, which, in a melted condition, is blown away or falls off, presenting a fresh surface to the disintegrating action of the oxygen. Steel and wrought-iron are cut with comparative ease. The cutting of cast-iron is more difficult, and in some cases is impossible, on account of the higher melting-point of the oxide formed; but, on the other hand, the cutting of cast-iron is seldom necessary, because of the comparative ease with which it may be broken in most cases. However, when necessity demands, the oxy-acetylene torch may be used with great effect in the case even of cast-iron, as Mr. Cunningham illustrates in his article. The subject is one of general interest to mining engineers, as the oxy-acetylene torch, in the hands of skilled welders or cutters, will prove of inestimable value in big plants, where there is a large amount of such work to be done, and even where repairs can be made locally, as well as in isolated districts. The equipment required constitutes one of the most effective insurances against lengthy delays resulting from those breakdowns that are the inevitable sequence to the operation of mechanical plants.



Nevada Consolidated

The Editor:

Sir—There are a few slight discrepancies in Mr. Parsons' interesting article on the Nevada Consolidated in your issue of March 5, to which I wish to call your attention.

On page 328, about the middle of the first column, Mr. Parsons says: "Gray became superintendent of the Ruth mine, in which capacity he served until 1907." On page 334 about four inches from the top of the first column he says: "In 1910 E. E. Vanderhoff succeeded Gray as mine-superintendent." As a matter of fact Mr. Gray left the Nevada Con. early in 1906. I visited the mine in June 1906 in company with Mr. Requa, and Mr. Gray was not with the company then, although I know he had been in January 1906.

Capt. Reuben K. Toms of Ely, Minnesota, became mine-superintendent in June 1906, under a two-year contract. It was Capt. Toms who was succeeded by Mr. Vanderhoff, but in June 1908. I was assistant mine-superintendent under Capt. Toms from July 1, 1906, to December 1, 1907, so that I know whereof I speak.

If the succeeding articles are as interesting as this first one, the series will be well worth re-printing.

Copper Hill, Arizona, March 10.

E. G. DEANE.

Labor Economics

The Editor:

Sir—I believe that you are mistaken in your statement on page 316 of the issue of March 5, in which you say that a bricklayer will only lay 600 bricks. From my own experience lately, on metallurgical plant construction, I believe that the average union bricklayer will lay 1200 or more common red bricks on new work.

Neither the Bricklayers Union, nor any other union that I know of, limits the amount of work that a man shall do. In fact, union mechanics are rather apt to raise a fuss about a man who will not keep his end up, and I doubt whether a man who was only able to lay 600 bricks could stay on a union job if the other bricklayers could help it.

Since 1898 there has undoubtedly been a falling off, both in the quantity and quality of work done by all classes of mechanics, but it has been due to causes with which the unions have had nothing to do. One great cause has been poor leadership and lack of knowledge of the details of their work, on the part of managers, superintendents, and foremen. Other causes are this employment of handy-men instead of real mechanics, with the

consequent lack of inducement for one to learn a trade thoroughly; and the employment of great numbers of mentally and physically slow-moving and inefficient foreigners.

The employment of the handy-man has already worked the practical extinction of the skilled machinist in this country, and it is the opposition, on the part of the unions, to the employment of handy-men at skilled trades that is one of the causes of the present effort to destroy the unions through the open-shop movement.

Canon City, Colorado, March 10. H. L. TURNER.

[We can readily perceive how an orthodox mason employed on metallurgical construction, where the walls were long, straight, and with few openings, might easily lay twice the average number looked upon by the unions as the standard allowable accomplishment. However, in order to verify the data in our editorial we asked a union official for an estimate of the average performance of a competent mason on ordinary building construction. His reply was, "From 350 to 400 brick a day". He said "brick" not 'bricks', which indicates that he knew his business.—EDITOR.]

The Colorado School of Mines

The Editor:

Sir—The committee appointed by the Legislature to investigate the management of the Colorado School of Mines has finished its public hearings of evidence and now has the matter under consideration.

A great deal of testimony was given by witnesses for both sides, much of which was unimportant and without particular point. Attorney Archibald Lee, for the defence of the Trustees and President, was emphatic in his denial of the charge that the reputation of the School had suffered during the past few years. He classed the evidence in support of the charges of the opposition as "hearsay" and spared no efforts in depicting his clients in glowing terms, reaching the climax when he classed Dr. Alderson with Washington and Lincoln. The only comparison that was brought out was that while Washington was known as the "Father of his country" Dr. Alderson was known in England at the time of his last trip there as the "Father of the shale-oil industry in the United States". Truly it may be said that a man is without honor in his own country.

To judge from the testimony of the Trustees and Dr. Alderson, it is a case of "everyone out of step but Johnny", with the Trustees and the President as Johnny

in this instance. They cried "slander" and "persecution" and cited mere incidents of gentlemanliness and big heartedness as their defence. Attorney Lee attempted to cloud the main issues with irrelevant matter and made an impassioned plea that was intended to arouse the sympathy of the committee for his clients.

Much time was wasted in taking evidence that the committee should not have been burdened with. The main issues are plain and the relief from the troubles should be apparent. It is not a matter of the integrity or morality of the Trustees or President; it is the problem of making the Colorado School of Mines the best that is possible. It happens that Dr. Alderson and the Trustees are involved, and, if the trouble is to be done away with, they will probably have to be removed. The system is to be blamed rather than the weaknesses of any particular man or group of men.

Considerable evidence was submitted that was not at all favorable to the defence and was of such a nature that the committee cannot dismiss it as hearsay or the product of wagging tongues. Considerable controversy developed about the value of the experimental mill at Golden. The opposition to the present management declared that the mill was valueless for use in giving students practical experience or for the use of citizens or companies in solving their ore-dressing problems, inasmuch as it is not properly arranged for the continuous milling of ore. It was held that besides housing a laboratory, it was best adapted for giving a good course in handling a shovel in view of the fact that the 'muck-stick' is a most important link in its flow-sheet.

In support of their claim that the test-mill is an example from various more or less prominent engineers and chemists. These letters were written before the mill was built several years ago and were all complimentary in character, as might be expected. It seems that none of these engineers were paid for their opinions and as they were all busy men they likely did not exert much effort in examining the matter. Regardless of that, however, they were not furnished with the basis for an opinion. The only information furnished to them was a plan drawing on a small scale showing various equipment placed about the mill. The men are not to be blamed for giving their opinions as they did, for they must have thought that the management of such a school would know enough to properly arrange the equipment to get efficient operation. There is no engineer who can form a correct opinion of the value of a mill by looking at its plan alone.

Another bunch of letters from English and Scotch sources were submitted to prove Dr. Alderson's ability. Naturally, they were very complimentary and diplomatic letters, inasmuch as they were addressed to the President of one of the foremost schools of mining and metallurgy of the United States. Finally, a bale of telegrams from various mining companies and other sources was submitted. These telegrams were replies to Dr. Alderson's inquiries as to the ability and standing of graduates of the Colorado School of Mines. Again the telegrams were

addressed to Dr. Alderson and were complimentary, as would be expected in view of the position that he holds. Apparently the writers of the telegrams did not know what use was to be made of them and supposed it was a regular inquiry of the President of the school for his guidance in its management.

Attorney George Manly, Dean of the Denver University Law School and counsel for the opposition, termed these letters and telegrams "barrages". Besides these barrages there was one by students from the school. Students from various countries and States were brought in by the defence and questioned on the stand as to the reasons why they had come to the school and as to whether they were satisfied with the courses and management. With the President and Trustees present, these students approved all things. They were a fine bunch of fellows and a good indication that the college men of today are not failing physically or mentally. This testimony might have been given under duress.

Attorney Lee showed positively that he considered his case very weak by his attempts to discredit the testimony of the witnesses for the opposition. He foolishly accused Commissioner of Mines Horace F. Lunt of neglect of duty because he had taken an interest in the proceedings and had assisted with the investigation. Instead of criticism, he should have commendation for the aid he gave in the best interests of the school and industry.

Mr. Lee then criticized the present writer for being in fairly regular attendance upon the hearings and accused him of having little to do or of being paid by some mysterious party for being there. The only interest I have in the matter is that of an engineer, one interested in the mining industry, a citizen of the State, and a humble taxpayer. Otherwise the matter is of no interest. If that is not license for a healthy interest I would be glad to know what Attorney Lee considers sufficient.

Most of the main witnesses were criticized in the above manner, with few exceptions. The testimony of Messrs. George Taylor, Thomas B. Crowe, and Bulkeley Wells was open to less criticism than that of the other witnesses.

It seems that the main issue is whether or not the School should be operated under the existing system of appointed trustees or be placed under the management of the Board of Regents of the State University or some new body with the supervision of all State schools. Other than this, the next most important question is whether or not Dr. Alderson is the proper head of the School. Judging from his reports on mining and shale properties and signed by him as "engineer", "consulting engineer", and his writings as a scientist and geologist, he is not the proper person to be at the helm of such an important institution. Such reports, written by a freshman at a school of mines, should be ground for expulsion forever. It is to be hoped that the committee will be wise in its decision and straighten this matter out for all time for the good of the School, the profession, and the industry.

D. H. FAIRCHILD.

Denver, March 8.

Russian Placer Mining—II

By L. A. Perret

DRIFTING AND TIMBERING METHODS. Ancient channels, bench and terrace placers, are, as a rule, mined in Russia by adits and tunnels. Opening by shafts is exceptional, although alluvial deposits at the bottom of valleys are always worked in this manner. The method of drifting consists in sinking a shaft to bedrock in the middle of the block to be mined, and then by driving drifts and cross-cuts at right angles, so as to divide the working-area into square pillars. These are mined by beginning at the border of the block and retreating toward the shaft or main haulage-way. The distance between shafts is generally 60 sagues (420 ft.)—the length (30 sag.) of the paystreak worked from a single shaft each way, and about the same as in Alaskan drift mines. The height and width of drifts and cross-cuts and the dimensions of pillars vary in the different districts, and even in the different mines of the same district, being multiples of the Russian unit, the arshine (3 arshines are equal to 1 sagene); just as in America and in the British dominions the dimensions of underground workings are multiples of the linear foot, the standard measure. A decimal system, by which the sagene is divided into 100 parts (sotki), is coming into general use in Russia.

The drifting method described permits the mining of the block as fast as possible; neither development nor exploration is considered. Few Russian undertakings can afford to develop their mines adequately previous to extraction, on account of the necessity for recovering the initial expenses as quickly as possible. Want of capital, from which Russian placer mining is suffering, accounts for the adoption of the method described. The output from one shaft is from 6 to 8 cu. sag. (76.2 to 101.6 cu. yd.) per day of 24 hours, when two-horse whims are used for hoisting; and from 15 to 25 cu. sag. (190.5 to 317.5 cu. yd.) with electric hoists. Thus it takes from one to three years to work out a block tributary to one shaft. These data are the same as in Alaska, where the amount of gravel hoisted per day is from 80 to 160 cu. yd.; and it takes about three years to exhaust an area of 400 sq. ft. of the paystreak, working from a single shaft. If the result is the same, then it passes my comprehension why American observers condemn the use of the horse-whim at Russian mines, and so strongly advocate the self-dumping carriers used in Alaska. In Russia, the purchase and maintenance of two or even four horses is far less than the cost of buying and operating a steam-hoist. Moreover, horses can be used at any kind of work, of which there is always much to be done at a Siberian mine; whereas a steam-hoist is only available to do that for which it was intended. I am not arguing against the adoption of machinery, but I do not understand the use of machinery *à tout prix*, for the mere sake of mechanics.

The pencil and the four rules of arithmetic must decide in such cases.

The Alaskan self-dumper was given a prolonged and fair test at the Lenskoie mines, but proved good for small plants only. The output of Russian individual drift mines of average size is from 5000 to 6000 cu. sag. (65,000 to 80,000 cu. yd.) per season. The Feodosievsky mine of the Lenskoie company, for instance, has a yearly output of about 400,000 cu. yd. American placer mining does not know of drift-mine production on such a scale. In Alaska (Fairbanks), claims over 1000 ft. along the paystreak are worked by two or three independent plants, each block of ground being a separate and distinct mine, on the same principle of which Mr. Hutchins speaks with so much disfavor when alluding to the Russian system for increasing production.

Russian drift-mining needs improvement, not on the



Alaskan small home-industry style, but on broader lines. This phase of the subject was considered at the Lenskoie mines over seven years ago. Inclined shafts were sunk a distance of 200 sagues (1400 ft.) apart, and endless-rope haulage installed, with automatic release of the cars at the mouth of the shafts, and automatic dumping into the boot or sump of an elevator. The cars run back by gravity to the head of the inclined shaft on the return track. From the bottom of the shaft a cross-cut to the boundary of the paystreak is driven for a length of about 10 sagues (70 ft.), sufficient for five or six loaded cars to stand on the track awaiting their turn to be taken up the incline. From the end of the cross-cut a double-track main haulage-way is driven straight both ways, either along the deepest portion of the channel in wide paystreaks (over 100 ft.), or along the rim of the paystreak in barren or poor ground. By driving cross-cuts at intervals of every 10 sagues from the main haulage-way to the boundaries of the paystreak, the ground is divided into long pillars that are breasted simultaneously from both adjacent cross-cuts, retreating toward the main haulage-way. A portion of the pillars, five sagues

155 ft. wide, is left for protection, this portion is subsequently mined from the haulage-way when its maintenance is required no longer. When a pillar is exhausted, the timber is removed and the ground allowed to cave. At the beginning of the work every other pillar is breasted, the intermediate ones acting as supports. When the caved ground is settled compactly, which takes from two to five days, the intermediate pillars are mined. From 50 to 70% in cases 90%, of the timber is recovered. When the work has been properly organized, from 50 to 60 cu. sag (about 650 to 760 cu. yd.) in 24 hours can be mined and taken up the inclined shaft by this method, which, I think, is as good as any other. It has been used in many mines in the Ural for the past 15 years, and was being introduced at the Lenskoe mines at the time of the visit of Messrs. Purington and Hutchins. The former showed little interest in this important improvement, and the latter, apparently, did not notice it at all, confining his statements on Russian mining methods exclusively to the old modes of procedure at the Cabinet mines, managed after Government fashion and always behind private enterprise; these cannot, therefore, be considered typical of Russian mining practice. Foreign critics often generalize with unpardonable recklessness as a result of observations made on a few isolated cases, and talk about Siberia as if its territory extended no further than that of a Californian county. Very heavy timbering is used in Russian mining, and a large percentage of it is recovered when drifting is done by the long-pillar method (I would not call it a long-wall method). But there is no possibility of recovering timber when the ground is worked by the small-pillar chess-board system, as the roof-pressure is so great that, frequently, 14 and 18-in. longitudinal reinforcing pieces of strong Siberian larch are flattened to a thickness of a few inches, and supporting posts of the same diameter are smashed in a couple of months. In Siberia, even where the ground is permanently frozen, the alluvium does not represent a compact mass; strata of permanently frozen ground alternate in the vertical section with thawed water-bearing layers. These conditions make drifting far more difficult than is the case where the ground is permanently frozen in a compact and solid mass, as in Alaska. Besides, the gold-bearing gravel in nearly all Siberian placers contains about 40% of pebbles and boulders of four or more inches in length. The ground is, therefore, freely permeable to heat, and liable to thaw under the action of the air circulating in the workings; and, therefore, to cave prematurely. The large proportion of coarse pebbles and boulders suggests a reason why thawing with steam-points has not been successful in Siberian mines, although it has been tried repeatedly. In the majority of cases the point strikes a boulder, which prevents its further advance. The hole must then be abandoned, as drilling with steam-points is not practicable. American engineers, when recommending methods used in their own country, do not pay sufficient attention to the difference in the composition and nature of the ground existing in Siberia as compared with that of Alaska and California.

Nearly all the alluvial deposits of the Ural and Siberia occur in broad open valleys with gentle slopes. The pay-streak, on the average, is from 300 to 400 ft. wide, frequently 1000 ft. and even as much as 1400 ft. It is obvious that, in the underground workings of such a wide channel, the roof pressure is many times greater than would be the case when drifting in narrow pay-streaks, about 50 or 100 ft. wide, packed in the V-shaped Californian and Alaskan gulches and creeks. Breastling with the American light timbering system is out of the question in Russian drift mines; an engineer would be easily convinced of this if he examined the nature of the ground. These considerations, not "childish fancies of ignorance", as Mr. Hutchins says, explain why the Russians use the heavy timbering prescribed by the mining regulations, to which foreign engineers and operators must also submit, whether they want to or not.

The Russian mining law is very strict as regards liability for accident; liberal indemnities must be paid to the injured. The engineer, manager, or technical man in charge of the work is held to be criminally responsible if it be proved that an accident is due to negligence in not taking the safety measures prescribed by law. In fact, accidents provoked by insufficient timbering are practically unknown in Russian drift mining. It is questionable whether Government tutelage is advisable in connection with safety regulations; but I think it would be preferable if, in all countries, safety and welfare legislation were so complete and perfect as to leave neither moral nor sound juridical ground for the labor-unions or professional organizations to busy themselves in the matter.

WASHING-PLANTS. It is to be regretted that the Alaskan sluice has been introduced in Siberia for large-scale placer operations, for which, from the engineering point of view, it is the poorest appliance imaginable. It is nothing more than the primitive launder of the early days, only of greater dimensions; and all its defects are retained. The washing of gold or platinum gravel is a crude process of concentration; yet to achieve success it is essential that the rudimentary principles of ore-dressing be observed. The most important factor to be considered is the uniformity of the size of the particles, and this factor must be applied as far as practicable without prejudice to the capacity of the washing-plant. This fundamental principle cannot be considered in sluice-washing, where everything from one foot long and smaller is fed, large boulders only being left behind. Usually the gravel of the Ural and Siberian placers contains 60% of boulders and coarse pebbles, mostly angular and sub-angular fragments, from one inch upward. Under such conditions the sluice has to perform, not only concentration, but also a heavy transporting function, for the accomplishment of which the amount of water must be considerably greater than is required for the treatment of the remaining 40% of undersize. Consequently, with the same amount of water, a sluice washes at least $2\frac{1}{2}$ to 3 times less material than a plant equipped with a device for screening the oversize.



MAP OF SOUTHERN SIBERIA

When all the gravel is fed to the sluice, the large fragments, moving slower than the water, contract the cross-section of the flow. Consequently, the velocity of the water increases at such points. The transporting power of a stream increases at the rate of the sixth power of its velocity, so that the presence of big fragments has a detrimental effect on the catching of the gold. The disintegrating function of the sluice is insignificant, because of the double task it has to perform, namely, that of settling the finer particles, as well as transporting the coarser and heavier fragments. Obstructive riffles, to promote disintegration and the saving of the gold, interfere with the capacity of the sluice; smooth obstacles cannot perform a disintegrating function and therefore do not catch the gold efficiently. Owing to these defects the results are inefficient, as is shown by Messrs. Purington and Smith,* who state that only 88.5% of the gold was saved in the first section of the sluice, which was 280 ft. long. This means that the bulk of the gold caught was scattered over 90 ft. This is a poor result. The gravel, previous to washing, was subjected to disintegration in the sump of the elevator feeding the sluice. Two elevators at the Lenskoie mines were intended originally for the Russian type of washing-plants then under construction: but, anticipating poor results with the Alaskan sluice, I suggested the use of an elevator, having in view its disintegrating effects. Because of a preliminary treatment in the boot of the elevator, the saving resulted as stated; without the elevator, it would have been less. The work of the Alaskan sluice is due to the action of a strong flow of water of comparatively great depth; and the idea is to counter-balance this adverse feature by increasing the length. The principle is unsound, but the idea may be applied successfully under special conditions. The work of the gold-catching device in Russian washing-plants is lessened by screening out the oversize beforehand, and by distributing the flow in a thin sheet over a wide area. This principle is the only correct one, and may be used with success for any kind of gravel. The

screening device used is the trommel, or a *chasha*,† a kind arastra with perforated bottom. Even the *kulibina*, so much despised by foreign engineers, operates on the same plan, and consists of two parts, the upper one being the sluice with obstructive riffles, chiefly to ensure disintegration. The discharge goes to a grizzly, through which the undersize drops to the lower part of the washing device, which is in the form of a table.

It is inexplicable why American engineers who favor a wide gold-saving area and the screening of oversize on dredges (where space is limited and valuable) do not adopt this principle for stationary plants. In many instances the Russian washing-plants may be of defective construction; the screening appliance may be of unsatisfactory manufacture or design: the saving tables may be too short or of too steep a grade; the riffles may be inadequate; but American engineers should appreciate the correctness of the idea and should attempt to improve its application, rather than to supplant it disdainfully by an inferior device such as the Alaskan sluice.

The following are taken from the records of well-designed Russian plants, with gravel elevators and revolving screens of special construction, according to close observation for a period of eight years:

Total length of tables, 38 ft., divided into three sections.

	%
Metal recovered on first, 10-ft., section.....	97.56
Metal recovered on second, 14-ft., section.....	1.95
Metal recovered on third, 14-ft., section.....	0.49

The loss was ascertained two or three times during each season by taking samples of one cubic sagene, each, in three or four places from the tailing-heaps, and carefully washing them on a Russian *stanok*, a kind of stationary rocker. The highest yield obtained, in one instance only, was 11 dolis per cubic sagene, corresponding to 0.6 grain per cubic yard; the average loss in the tailing proved to be from 6 to 8 dolis per cubic sagene of undersize, which means a loss of 3 to 4 dolis per cubic

*Min. Mag., September 1916.

†For description, see article by J. P. Hutchins, *ibid.*

sagene of gravel, or 0.16 to 0.25 grain per cubic yard, which is practically nothing. The tailing heaps are still in place and may be re-sampled if there is any doubt concerning the accuracy of these records. Similar results have been obtained in washing alluvium containing platinum, which has a higher specific weight than gold; but this makes no difference, as washing is merely a question of inclination, and proportion of water to the volume of gravel. Concentration is not so much a matter of the specific weight of the metal recovered, as the difference between the specific gravities of the metal and the waste. This ratio is the same with gold and the constituents of gold placers, as with platinum and the minerals of the olivine group of which platinum-bearing alluvial deposits are formed.

A washing-plant such as described above was being erected at the Lenskoie (Feodosievsky) mines, and its construction almost completed at the end of the summer of 1914. It was my intention to enclose it in a heated housing and to feed it from two inclined shafts (and one or more vertical shafts, as may be required) connected by heated corridors with the automatic car-dump of the feed-elevator, so as to ensure a capacity of 100 cubic sagenes or more per 24 hours. In this way it would be possible to wash the whole of the output and to avoid the collection of winter dumps.

It will be seen from the following table that the labor required on a modern Russian washing-plant is far less than would be the case of a sluice, according to the statements of Messrs. Purington and Smith:

	Sluice	Russian plant
Engine and boiler.....engineers ..	2	2
firemen ...	2	2
Motor of elevator.....motor-men ..	2	..
General work.....oilers	2	2
Sluice	10	..
nozzle-men ..	2	..
Tailing and oversize chute.....	2	12
Dump	20	12
General	4	2
	—	—
Total for two shifts.....	46 men	32 men

The average capacity of an Alaskan sluice of normal size is from 400 to 450 cu. yd., whereas the capacity of a Russian washing-plant is from 1300 to 1900 cu. yd., hence the gravel washed per man in the case of the sluice is about 10 cu. yd., and with the Russian plant, from 40 to 60 cu. yd. Mr. Purington thinks the supplanting of Russian washing-plants by Alaskan sluices an improvement, although only 67% of the winter output was handled and with the results already mentioned. It is to be hoped that the performance of the sluicing-plants erected at the Lenskoie property will convince the mining community in general of the inferiority of the Alaskan sluice as compared with a well-designed device on the Russian system. The sluice is only suited to small operations, for washing gravel of a more or less uniform size, and where plenty of grade and dump-room is available, as is the case on American placers. To apply the Alaskan sluice under Siberian conditions indicates an adherence to routine and conservatism.

When the first Alaskan sluice was under construction on the Lenskoie mines the Russian engineer pointed out to the constructor, Mr. Smith, that he was giving too small a grade, and suggested that arrangements should be made so as to be able to increase the incline if found necessary. But Mr. Smith knew better and went on with the 2½ in. grade. The result was that 20 minutes after the washing was started the sluice was clogged. The whole plant had then to be re-constructed at considerable expense. Sluices were then erected with a grade of 1 in 10, necessitating twice the amount of water required for plants of the Russian type. In America, grades are commonly from 2½ to 7 in. per 12 ft. box; 14 in. is rare; whereas in Russia, unscreened gravel as it comes from the workings will not be transported unless the grade is at least 1 in 8, which corresponds to 18 in. per box. Thus the fall of a 280-ft. sluice would be 35 ft. A dump of ordinary height, say five sagene, or 35 ft., at the tail end of the sluice, would require an elevation of 70 ft. at its feed end, above the floor of the dump-room. Owing to the moderate relief of most of the Russian placer regions, and the insufficient grade of the valleys and the placer-channels, such elevations are not usually available. This is another reason for the unsuitability of the Alaskan sluice for Russian mining operations. Because of the smooth topography of the Ural and Siberian districts, and the gentle grade of the valleys, the Russian plants are always erected on the floor of the valley, if possible on bedrock laid bare by previous workings, and the tailing is elevated. In open-cut work the pit itself is used for dump-room as the work proceeds up-stream. I think it good policy to transport the gravel directly to the washing-plant, and to elevate the tailing and oversize, instead of the reverse, as Mr. Hutchins suggests. I cannot understand how "if washing-plants were placed on adjacent hillsides, gravity-water could be flumed or ditched to them". The lower the point where the plant is situated, the easier it is to conduct water by gravity. For further details about Russian washing-plants and the disposal of tailing I would refer to my paper on the subject.‡

It is a general belief in foreign mining circles that the loss from the Russian plants is exceedingly high, and amounts to 20 or even 33½% of the total gold in the gravel. It is also maintained that there is a field for foreign capital in re-treating the tailing-heaps of the Russian placer mines. This belief is fostered by statements made at random about the inefficiency of the Russian washing-plants. Naturally, there are instances in Russia, as everywhere, when the losses of gold in the tailing are heavy, but the shareholders of the Orsk Gold-fields have had an opportunity of appreciating the truth of such statements. The company, for five or six years after its inception, could make no profit while re-working the tailing of the former Russian company. After 30 years experience in Russian placer mining, I advise against generalizations and superficial statements in this respect.

(To be Concluded)

‡Trans. I. M. M., Vol. 21.

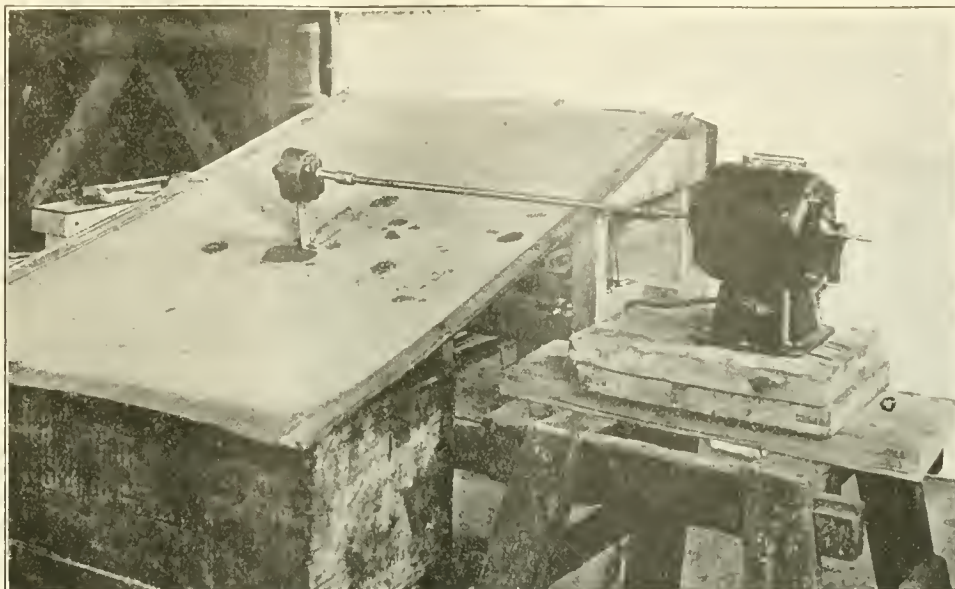


FIG. 1. FIRST EXPERIMENT IN WHICH VIBRATIONS WERE OBTAINED BY FASTENING THE BEARINGS OF AN UNBALANCED PULLEY TO THE SCREEN

The Development of a Vibrating Screen

By B. A. Mitchell and G. B. Rosenblatt

In 1917 the presence of excessive moisture in the crushed ore at the mills of the Utah Copper Co. at Garfield caused continual difficulty from clogging of the screens then in use. During that part of the year when wet ore was delivered to the mills their capacity was frequently restricted by the amount of ore that could be put through the screens, and the only way that reasonable capacity could be secured was by using screens of larger mesh and by having operators continually scraping and pounding to keep them open. In fact so bad did this condition become during the winter that the metallurgists considered the advisability of making extensive changes in order to substitute wet for dry crushing, with the consequent increase in roll-steel consumption and screen-wear. An alternative to this added investment and increase in operating cost was some method of screening other than that of the screens in use. It was thought that high-frequency vibration of the screen-cloth itself might accomplish the desired results of permitting satisfactory screening of the rated tonnage despite the high content of moisture.

An attempt was made to secure this high-frequency vibration by wiring a system of bars to the screen-cloth of a shaking screen. This proved temporarily effective, but the mechanical cutting of the cloth made the screens extremely short-lived.

Experiments were then made with a screen operated by repeated impact of mechanical hammers, but this did not improve results notably as the rate of vibration was not sufficiently high. To increase the rate of vibration a

screen of this type was equipped with a pneumatic vibrator such as is used for shaking down the sand in the molding-machines of foundries. This gave 4000 to 5000 vibrations per minute. Experiments proved the desirability of high-frequency vibration, but the apparatus as installed was not mechanically adapted to continuous operation such as is required in a mill. It was, however, noted that the high-frequency vibration did improve the screening effect, obviated blinding of the meshes, and raised the screening efficiency despite the high content of moisture of the ore.

The next step was to substitute for the pneumatic vibrator a small unbalanced pulley with its bearings fastened to the screen-cloth (Fig. 1). This was driven by flexible shafting from an adjustable-speed motor. Vibrations running from 1500 to as high as 4000 per minute were tried. At the low rate the screen-cloth vibrated unevenly and with high but unstable amplitude. As the frequency of vibration was raised to approximately 2000 and higher, these unsatisfactory conditions disappeared, and at about 2500 vibrations per minute the screen-cloth vibrated evenly and uniformly. Apparently there is a critical point where the racking and jolting action disappears and where smooth and effective vibration takes its place. The screen showed decidedly less tendency to clog as soon as the vibrations became smooth; in fact, the large number of high-frequency impacts of small amplitude were much more effective than fewer impacts of greater amplitude. This was established definitely by screen-analysis of the products.

A careful inspection of the conditions causing better screening developed some interesting facts. The path traveled by the individual wires of the screen was studied when vibrated both by the pneumatic device mentioned above and when vibrated at both high and low frequency by the unbalanced pulley. When the vibra-

different portions of the screen, there evidently being nodes at the point where the unbalanced pulley was attached and at the two points where the screen-cloth was fastened to the frame.

When this circular vibration was imparted to the individual screen-wires they did not push directly up against the material lying on the screen, but rather had an action that rolled the material over the individual wires of the mesh. As a result the number of individual particles in the crushed ore that came in contact with each wire during a given period was considerably increased, and the number of particles that was forced into the openings between the wires proved to be much greater with the circular type of vibration than with the rectilinear type.

These experimental investigations were well substantiated by screen-analyses of the products from both types of vibrating screens applied on a large scale to the screening of wet ore. The screen operated at high fre-

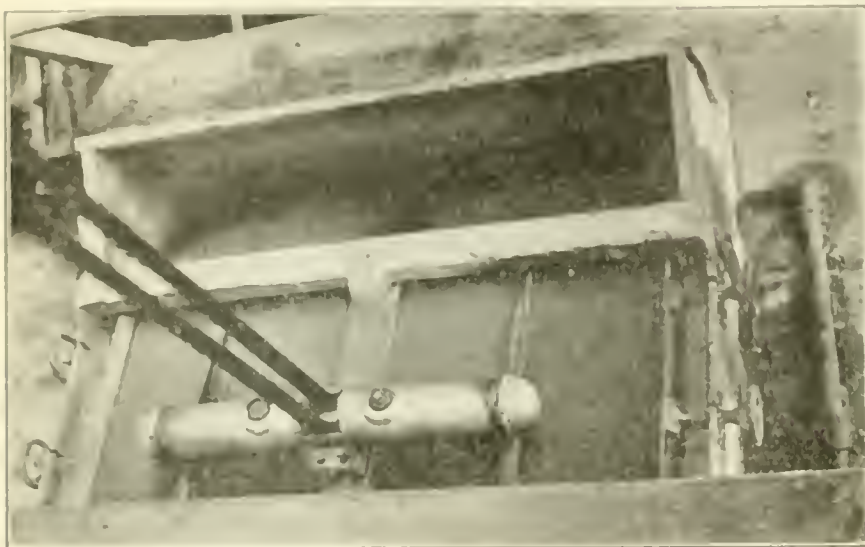


FIG. 2. THE FIRST BELT-DRIVEN VIBRATOR

tions were imparted by the unbalanced pulley the path of travel of the individual wires of the mesh was found to be decidedly different from that caused by the pneumatic vibrator.

When using the pneumatic vibrator the individual wires in the screen traveled in paths whose plane coincided with the position of the wire when at rest, these planes being perpendicular to the surface of the screens; in other words, the vibration caused the wire of the mesh to be pushed straight up into the material on the screen, and then to fall straight away from this material.

The vibrations imparted by the unbalanced pulley when operated above the critical speed caused the wires of the individual meshes to travel in circular orbits. At low frequency the orbits were elliptical, becoming flatter and flatter as the frequency decreased; but above the critical speed the orbits appeared truly circular independent of the frequency. The action of each wire parallel to the axis of the pulley was similar to that of a child's skipping-rope, assuming the rope to be held reasonably taut. The amplitude of vibration, that is, the diameter of the orbital path, varied at

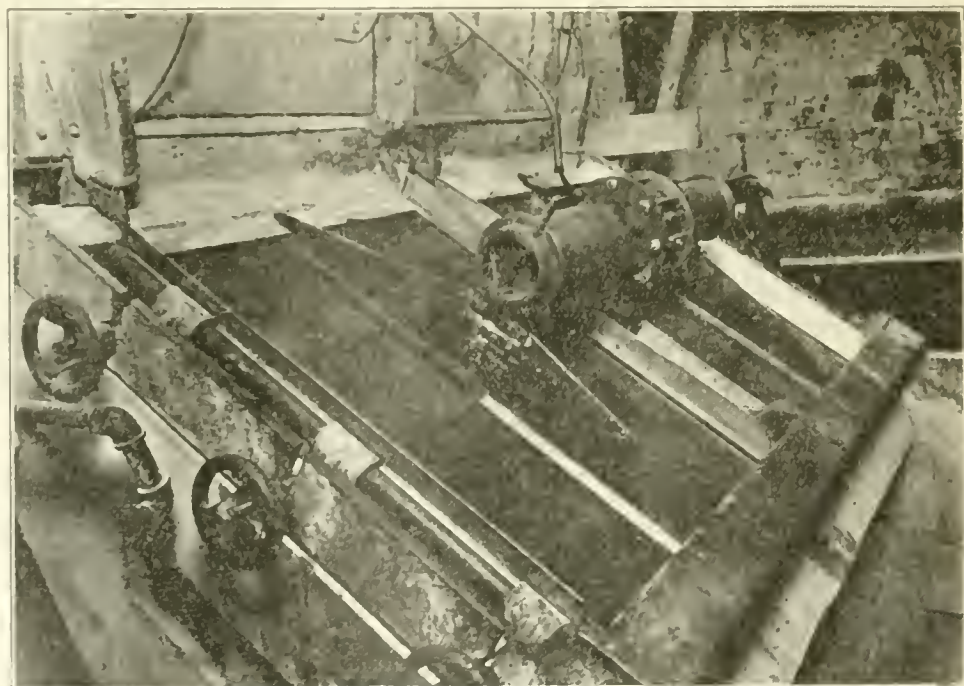


FIG. 3. THE FIRST VIBRATOR WITH A DIRECT-CONNECTED MOTOR

quency with a vibrating pulley sized a greater tonnage, and sized it more effectively, than the screen with the rectilinear vibrations. The efficiency of the sizing was determined by examining the reject from the screens for material which was of proper size to pass through the screen, but which failed to do so. The rotary vibrations of the screen-wires evidently gave maximum opportunity for the segregation of undersize in the mass of ore on the screen.

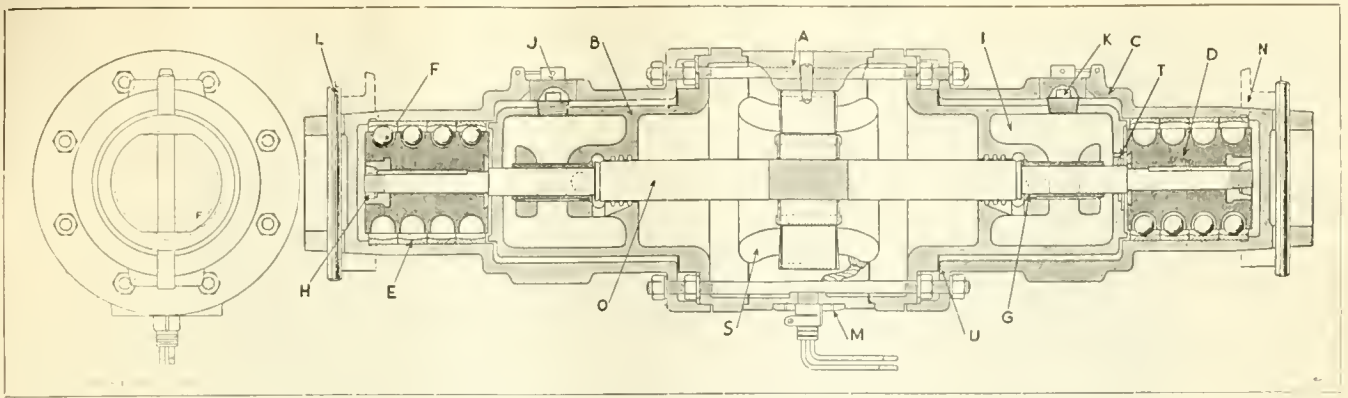


FIG. 5

DETAILS OF VIBRATING MECHANISM

- | | |
|--------------------------------|---|
| A—Frame of motor | J and K—Plugs in opening to oil-reservoir |
| B—Motor bearing-bracket | L—Pin keying vibrator unit to transmitting plates |
| C—Vibrator, housing ball-races | M—Hardened-steel seating-ring |
| D—Ball-cages | N—Vibration-transmitting plates |
| E—Hardened-steel ball-races | S—Motor primary coils |
| F—Balls | T—Packing |
| G—Bearings for shaft | U—Gasket |
| H—Locknut | |
| I—Oil-reservoir for bearing | |

end, then at the other, pressing out against the housing and driving the housing toward the screen. This gave the housing an oscillatory motion with two impulses per revolution, these impulses being transmitted from housing to screen through two plates attached to the outside of the housing, one at each end, and fastened to the screen-cloth.

The device was simplified further by doing away with

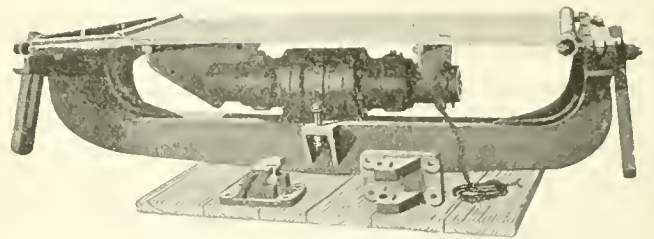
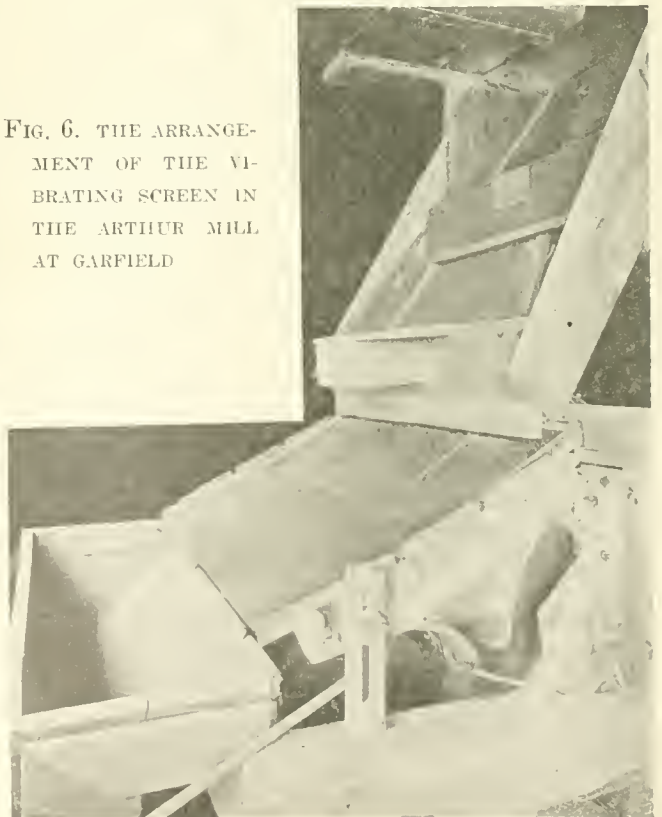


FIG. 4. IMPROVED SCREEN AS NOW MADE

The experiments described above definitely established the advantages of rotary vibration for mill-screening. The crude device of an unbalanced pulley driven by a flexible shaft and fastened to the screen-cloth by its bearings was replaced by a mechanism termed a 'vibrator', consisting of a belt-driven shaft with eccentric weights, one at each end, all enclosed in a suitable housing, which was provided with plates for transmitting the vibrations to the screen-cloth (Fig. 2). This apparatus met most of the requirements for regular operation and imparted the proper motion to the screen; but certain weaknesses became evident that apparently could be eliminated by improved design. The principal shortcoming was excessive wear of the bearings, caused by the unbalanced eccentric weights on the ends of the shaft. If the effect of these weights could be obtained without connecting them rigidly to the shaft the bearing-wear could undoubtedly be greatly decreased. This problem was finally solved by substituting for the eccentric weights a symmetrical cylinder of light weight on each end of the shaft. These cylinders were provided with pockets into which were fitted spherical metallic weights. Actually these weights were balls from a bearing. The balls at one end of the device were placed in pockets diametrically opposite to those at the other end. As the shaft was revolved there was a tendency to throw these balls out of their pockets, owing to centrifugal force; they impinged on the inner side of the vibrator-housing. Hardened-steel races were provided for the balls to travel upon. It was found that this mechanism, when driven at proper speed, transmitted to the screen vibrations exactly similar to those developed by the unbalanced eccentric weights. The shaft with its cylinders, or 'ball-cages' as we termed them, acted as a gyroscope, revolving with its axis always in the same line. The supported weight being very light, the wear on the bearings proved negligible. The vibrations were secured by the unbalanced balls, first at one

FIG. 6. THE ARRANGEMENT OF THE VIBRATING SCREEN IN THE ARTHUR MILL AT GARFIELD



the belt drive, and substituting a small two pole alternating-current direct connected induction motor for the drive pulley at the centre of the shaft. This permitted making the vibrator totally enclosed and self contained, a complete unit in itself (Fig. 3). The motor ran at about 3500 r.p.m., producing a frequency of vibration that gave excellent results.

As in the earlier experiments the vibrator was mounted on top of the screen, but during endurance runs difficulty was experienced in keeping close contact between the transmitting plates and the screen. Accordingly the position of vibrator and screen was reversed, at first experimentally, the vibrator being placed below the screen cloth so as to allow the load on the screen to press the cloth against the vibrator-transmitting plates. This arrangement immediately demonstrated that it had definite advantages. The mechanical arrangement was superior, because it left clear the top surface of the screen. The transmission of vibrations was as perfect as could be desired, and, what was more surprising, the screening action was better with the vibrator underneath than on top of the cloth. It would seem as if the transmission of the vibrations from underneath drove the individual wires of the mesh up into and through the material on the screen more effectively. That some such action actually takes place can be demonstrated by reversing the direction of the motor driving the vibrator. If the direction of rotation is such as to cause the wires of the mesh to travel in an orbit counter to the path of the ore passing over the screen, the capacity of the screen will be greater than if the orbit of vibrations coincides in direction with the path of the ore traveling over the screen.

The construction of the improved screen in its present form followed (Fig. 4). The device consists simply of a suitable frame for holding the screen-cloth in proper tension, the vibrator proper, and the plates for transmitting the vibrations to the screen. The vibrator now used is shown in cross-section in Fig. 5. A typical arrangement of the present form of screen as used at the Arthur mill at Garfield is illustrated by Fig. 6.

The outstanding characteristics of the present form of screen, apart from its mechanical simplicity, are the large tonnage that can be screened with a given area and the almost perfect screening that can be accomplished due to the character of the vibrations. The operation is smooth, free from racking and jarring, and all tapping and pounding devices are done away with. The power required by the vibrator is small, being approximately $\frac{3}{4}$ to $\frac{1}{2}$ hp. for a 4 by 6-ft. screen. The consumption of power is largely independent of the mesh of the screen or the material screened. The work done by the small motor in the vibrator is to drive the balls out against the vibrator-housing. This work is the same no matter what the nature of the material on the screen. The wearing parts of the operating mechanism are few: they are simple and rugged, and have long life. Twenty-four months of service by this type of screen at the Arthur mill has demonstrated these facts.

The screen has been tried for coal, coke, slag, salt, sand, gravel, and fertilizer, as well as crushed ores, and reports of its operation are favorable. It has proved particularly successful with wet and sticky materials, and, as noted above, it was difficulties with this class of ore that led to its development.

The Sampling of Gold Bullion

The position of a mine assayer who does not enjoy the manager's confidence in his ability is not likely to be a bed of roses. Conversely, one must admit that an element of doubt in the managerial mind as to the correctness of the assay-results must be a constant cause of anxiety. It is often the custom to judge of the capability of the assayer by the closeness with which his bullion assays agree with those of the buyers; indeed it is considered of such importance that a greater difference than one-thousandth in mill bullion and two-thousandths in cyanide bullion immediately calls for arbitration, the cost of which is invariably borne by the sellers. In the opinion of H. R. S. Wilkes, who contributes to the 'Transactions' of the Chemical, Metallurgical & Mining Society of South Africa, a bullion assay may possibly be a criterion of the carefulness of the assayer, but as a criterion of his technical skill it is almost worthless, for it is one of the simplest estimations he is called upon to perform. When, however, the gauge of the correctness of the assayer's result is based on a comparison with the mean of the buyer's and the arbitrator's, then as a criterion of carefulness and skill it is worse than useless, being often misleading, and for the following reasons:

1. The estimations of the mine assayer and those of the buyers are never made upon the same sample.
2. The methods of sampling, and the preparation of the metal for sampling, are rarely if ever identical.
3. Errors in describing the bars and their samples are sometimes made.

Speaking generally, the sampling methods employed on the Witwatersrand may be classed under three heads: dip-sampling, drill-sampling, and corner-chipping. With gold of 850 fine there is little likelihood of appreciable difference in result, irrespective of the precise method of dip-sampling. Errors may arise, however, as a result of insufficient stirring. Drill-sampling is liable to result in error through liquation, especially when the metal is poured in too hot a condition, because of insufficient stirring before pouring, and on account of the inclusion of dust and minute particles of slag. When the bar has been acid-cleaned the enrichment of the first borings (usually discarded by careful samplers), may influence the result. Corner-chipping is subject to all the disadvantages of drill-sampling, though there is less likelihood of the inclusion in the sample of foreign matter. Incidentally, it is suggested that a mixing of sample numbers may happen in the buyer's offices. All the above-mentioned disabilities are lessened in degree as the fineness of the gold improves, and this explains why it is so seldom that wide differences occur.



THE TIDEWATER MINE, ON VANCOUVER ISLAND

The Tidewater Mine

By D. M. Drumheller Jr.

The property of the Tidewater Copper Co. is located on Sidney Inlet, a small land-locked harbor on the west coast of Vancouver island, 150 miles from Victoria, B. C. Transportation is entirely by ocean steamships.

The topography and climatic conditions are similar to the coast of south-eastern Alaska, the mountains rising abruptly from the water's edge to elevations of five thousand feet. The slopes of the mountains are steep and are heavily covered with timber. The precipitation, mostly as rain, averages from 150 to 180 inches per annum and is practically continuous except during the months of July and August.

The ore occurs as a replacement in beds of limestone, the limestone being a part of a series of interbedded andesite flows and limestone, the whole having been more or less metamorphosed and underlain by a grano-diorite batholith.

The copper occurs as chalcopyrite and bornite in about equal proportions in a gangue composed of garnetized lime with magnetite. The beds now being mined show a width of 20 to 30 ft. and dip at about 35°. The andesite forming the walls stands well, the only support for the roof being an occasional pillar. There is a little silver and practically no gold in the ore.

The mill is a straight flotation plant of a nominal capacity of 300 tons per day. Mill-heads are crushed to minus $\frac{1}{2}$ -inch, and then fed to a 6-ft. by 5-ft. Traylor ball-mill, the product of this being classified in a Dorr duplex classifier overflowing minus 48-mesh material. The oversize from the classifier is split for further grinding between a 5-ft. by 22-ft. Allis-Chalmers tube-mill and a 5-ft. by 4-ft. standard ball-mill, the product of these mills going directly to the Peterson flotation cells.

At first glance it may appear that there is insufficient classification in this plant but from practice it has been found that any material too hard to be ground to minus 48-mesh in passing through these mills carries so little copper that it can be discarded with the tailing without appreciably increasing the loss and at the same time saving the ball and liner consumption that would result from reducing this very abrasive material.

The Peterson flotation cell is of the pneumatic type. The cell itself is a cylindrical tank with a conical bottom. A canvas hose is used for the porous medium and is suspended just above the conical bottom. The hose, with proper pipe-connections, is wound spirally and laid on top of slats fastened in the tank. Strips of old belting are used to hold the hose to the slats. A spigot at the bottom of the cone draws off any oversize. This spigot discharge is run to tailing with the exception of that from the first rougher, which can be sent to the classifier, and that from the cleaner, which is returned to the first rougher.

Five cells are used as roughers and the last cell at the lower end of the mill as a cleaner. Power input to the blower equals 2.8 hp-hr. per dry ton of original feed. The oil used is a mixture containing 80% coal-tar, 15% coal-tar creosote, and 5% crude pine-oil. The Minerals Separation machine is not being used as it has been found that the pneumatic cells make a higher-grade concentrate and a cleaner tailing, besides being more easily operated.

Power is furnished by Pelton water-wheels operating under a head of 590 ft., each important unit having a separate wheel. A complete steam-power plant is arranged to drive any or all of the equipment, this being necessitated by the shortage of water in the summer and

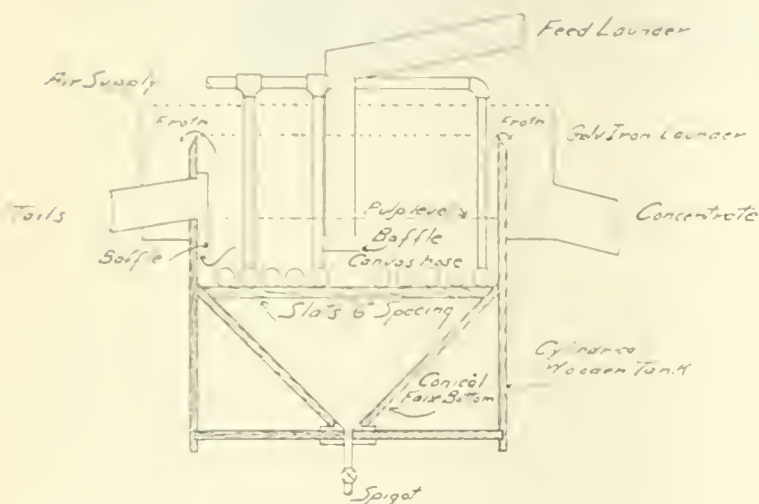
during severe cold spells in the winter. No water storage for power purposes is available, the run off only being utilized so that in case of a sudden frost or during a dry spell steam-power must be used.

The mill was completed and put in operation in October 1920. On January 1, 1921, owing to the collapse of the copper market operations were temporarily discontinued.

Metallurgical results during the month of December were:

	Copper, %
Heads	1.86
Tailing	0.09
Concentrate	37.62
Recovery	95.4

A possible by product of the operation is the magnetite.



PETERSON FLOTATION CELL

now lost in the tailing. Analysis of a gravity concentrate of the magnetite obtained by laboratory test shows:

	%
FeO	76.73
Al ₂ O ₃	1.09
Cu	0.76
S	0.25
CaO	none
Mn ₂ O ₃	2.10
SiO ₂	3.40
MgO	2.14
P	0.05
Ni	1.31
Mo	1.02

During the temporary suspension of milling operations, diamond-drilling and underground development are being continued.

SWEDEN is importing large quantities of American copper, states a consular report. The importations increased from 10,000 tons during the first nine months of 1919 to 15,000 tons for the corresponding period in 1920. The development of the Swedish electrical and electro-hydraulic and electro-chemical industries explains this increase.

Rock Temperatures in South Africa

Rock temperature in the Witwatersrand increases at the rate of 1° F. for each 254 ft. in depth, according to E. H. Clifford who contributes to the Institution of Mining and Metallurgy a paper on a scheme for the working of the City Deep mine at a depth of 7000 ft. The rock temperatures from 6000 ft. onward are approximately as follows:

6000 ft.	89° F.
7000 ft.	93° F.
8000 ft.	97° F.

The air underground is, as a rule, nearly saturated, and if no preventive measures were taken the atmospheric conditions at a depth of 7000 ft. would be such as entirely to prevent the working of the mine. The problem resolves itself into two separate enquiries—first, to discover the effect of different atmospheric conditions on the human organism, and second, the means of controlling the atmospheric conditions. Until quite recently, the object of mine ventilation was to obtain a pure atmosphere. In certain instances, the dilution and removal of poisonous or explosive gases was the important question, but, generally speaking, if the air was pure in a chemical sense, it was assumed to be satisfactory from a physiological standpoint. Although it has been realized that temperature and humidity were factors of importance, it is to the recent researches of Dr. Leonard Hill and his associates, that we owe an adequate statement of the physiological theory of ventilation. Apart from the presence of definite poisonous or explosive

gases and of certain kinds of dust, the most important condition of mine air is its cooling power on the human organism. Little or nothing can be done with regard to humidity; velocity as a cooling power, though it should be made use of wherever possible, has in practice rather serious limitations; and reliance must be placed on the remaining factor—temperature. Any ventilating current must abstract some of the heat from a mine by virtue of the specific heat of the air; and, if water is present in the workings, by its evaporative power. The quantity of heat so abstracted would depend in general on the difference between the initial and final temperatures and absolute humidities. The supply of heat to the air-current is derived from the rocks, from men, animals, illuminants, water, and explosives; from electric power used underground; and also, in some instances, from chemical change—this last being a negligible factor on the Witwatersrand. In order that a reduction in air temperature may be brought about, the quantity of heat removed by the air-current must be greater than the quantity of heat supplied to the air-current, and that this may be done the important points to attend to are quantity of air in circulation, initial temperature, and initial moisture content. It was considered that for the particular case of the City Deep, the heat-absorbing power of a large volume of air was adequate to bring about a general reduction of the mine temperatures.

Oxy-acetylene Welding and Cutting at Anaconda

By Thomas W. Cunningham

The oxy-acetylene process of welding was first put in use at the Anaconda reduction works of the Anaconda Copper Mining Co. in 1909, but at that time the blowpipes and generators for acetylene gas were not safe or efficient. The equipment then consisted of a portable oxygen and acetylene generator mounted on a four-wheeled truck. The acetylene generator was a carbide-to-water type with a capacity of about 25 lb. of carbide, and would generate gas at pressures anywhere from a few ounces per square inch to what would today be considered an excessive pressure.

The oxygen was generated in two small retorts made of six-inch pipe about 18 in. long, from chlorate of potash and manganese di-oxide, acetylene gas being used for heating. The oxygen was piped into a receiver of 30 in. diameter, 40 in. long. One charge in the retorts would give almost 100 cu. ft. of oxygen. This apparatus was used for about three years, but owing to the impurity of the gas produced it was not possible to get good results when welding.

In 1912 there was installed the Linde Air Products Co.'s blowpipes and generators. Our engineering department was then engaged on the remodeling of the first section of the copper concentrator, and it was here the real worth of welding and cutting with gas was demonstrated. Most of the structural steel in the old building that had to be taken out to make room for the new machinery and equipment was cut out by means of the blowpipe. All of the feed-distributors, launders, and classifiers in the remodeled plant were oxy-acetylene welded, $\frac{3}{16}$ -in. tank-steel being used in their construction.

The next important job was the welding of the launders and feed-distributors for the 20-deck round tables in the then new round-table building. There were 10 launders on each table with 142 ft. of welding to each launder; there being 20 tables in all, a total of 28,400 linear feet of welding was necessary.

In 1913 the largest oxy-acetylene welding job yet undertaken at this plant was started. This was the welding of the plate-steel roof of the main flue; 1711 steel sheets, No. 9, 3 ft. 6 in. by 120 ft. were used. These were laid end to end six sheets wide. The welding consisted of the following:

Number of seams	Length in ft.	Ft.
257	120	30,840
7	856	5,992
7	100	700
35	80	2,800
300 4-in. pipe for test-holes.....		3,750
15,420 washers, $3\frac{1}{2}$ in. diam.....		14,135
Add about 10% for double seams.....		5,820

Thus the total number of linear feet welded was 64,037, or about $12\frac{1}{2}$ miles.

The work of taking off the old roof, which included cutting the old sheets and rivets by means of the oxy-acetylene torch, was started on August 1, 1913. On August 10 the first sheets laid were welded. The entire job was finished on November 20, 1914. Thus a total of 333 days was consumed, with an average of 7.65 men per day welding and cutting.

The material used on the job consisted of the following:

50,000 lb. carbide;
8,500 lb. $\frac{3}{16}$ -in. Norway iron rods;
400,000 cu. ft. of oxygen.

The welding and gas-generating equipment then consisted of two 300-lb. carbide-capacity acetylene generators of the pressure type:

One 28-cell electrolytic oxygen-generator having a capacity of 100 cu. ft. per hour;

One three-stage oxygen-compressor for high-pressure cylinders, capacity 500 cu. ft. per hour, compressing to 2000 lb. per square inch;

One two-stage oxygen-compressor for low-pressure cylinders, capacity 200 cu. ft. per hour, compressing to 350 lb. per square inch;

48 low-pressure oxygen-cylinders;

25 high-pressure oxygen-cylinders;

Eight welding blowpipes;

Two cutting blowpipes;

12 oxygen-pressure regulators;

Six acetylene-pressure regulators, hose, wrenches, and other accessories.

The present equipment is as follows:

One 500-lb. carbide-capacity Oxweld Duplex type stationary acetylene-generator for shop use;

One 100-lb. carbide-capacity Oxweld portable generator;

Three 50-lb. carbide-capacity Oxweld portable generators;

Forty-eight 300-cu. ft. Presto-Lite acetylene cylinders;

Twenty-four 100-cu. ft. Presto-Lite acetylene cylinders;

One Castner Electrolytic Alkali Co.'s lavoisite process oxygen-generator, capacity 500 cu. ft. per hour, at atmospheric pressure;

One three-stage oxygen-compressor, capacity 500 cu. ft. per hour to 1800 lb. per square inch gage-pressure.

Oxygen and acetylene gases are piped from the generating plants to the machine and boiler shops for shop-work. The gases are usually taken to the various other buildings of the plant in cylinders, but in some cases the acetylene gas is generated on the job with one or more portable generators.

Sufficient oxygen-cylinders, regulators, cutting and welding blowpipes, acetylene-regulators, and other accessories are on hand to employ regularly from 15 to 18 men.

With this later equipment many jobs of an extraordinary character have been accomplished. One worthy of special mention in connection with the application of the oxy-acetylene blowpipe in cutting cast iron was as follows:

There was a change to be made in the roasting furnaces at our No. 2 roaster plant. These furnaces are of the Wedge type. In order to make the required change it was necessary to dismantle the lower end of the central shaft of each furnace. The central shaft is five feet in diameter, made of boiler plate with an iron casting riveted thereon to hold the gears and equalize the bearings, and a cast-iron roller retainer. This roller retainer carried the weight of the entire central shaft, 10 to 15 tons.

In order to remove the castings on the central shaft, it would have been necessary to raise the whole shaft 12 or 15 in., which was not possible without dismantling the arms, arm-holders, water and air piping, feed-hoppers, and other parts on top of the furnace. Without dismantling, the shaft could have been raised not more than three or four inches, which was not high enough to allow the castings to clear the central shaft or the foundation of the furnace. The roll-retainer then used was a spider casting six feet in diameter with a T-section rim and two inches cross-section, with a pin-bearing on the bottom 12 in. long, all cast in one piece. If this one piece could have been taken out, the other castings would have come out easily; to get it out, the rim T-section, which was six by eight inches and two inches thick, would have to be drilled or broken in two places, four ribs or spokes of the same size broken off, and the pin on the bottom, eight inches in diameter with an inch hole in the centre, drilled or broken. Drilling or breaking these castings was out of the question, because there was not space enough between the bottom hearth of the furnace and the foundations to use an air-motor or sledge-hammer. Dynamite could not be used to break the casting for the reason that the jacks and cribbing necessary to support the weight of the central shaft and its appurtenances might be blown out or damaged sufficiently to let the shaft fall and wreck the whole furnace, or the detonation might jar the brick-work in the central shaft and the furnace-hearths to such an extent that the cost of repairing would be very little less than the cost of removing the brick-work in the first place.

Men were put to work to dig away the concrete foundation and others to undertake to drill or break the spider, but after two or three days work with very little headway it was decided to employ the oxy-acetylene torch to melt the spider in two, and if possible, to melt off the bottom pin. Work was started and the first one taken off was melted in about five hours. It was thought that better time should be made on the job and an old blowpipe was taken and remodeled, the idea being to get more oxygen through the cutting jet, and a greater pre-heating flame so as to pre-heat the cutting oxygen just before it came in contact with the casting. With this blowpipe one casting, upon which four cuts on the spokes and two on the rim were made, 84 linear inches of material two inches

thick were cut off in 70 minutes. The pin, eight inches in diameter and two and one half inches thick, was cut off in 40 minutes. One hour and fifty minutes were consumed in cutting 109 linear inches of material. The oxygen used was considerably greater than would have been necessary for the same amount of cutting on steel plates or steel castings. The acetylene consumption was practically the same as for steel. Oxygen was used at 75 lb. pressure per square inch and acetylene at 5 lb. pressure.

Some idea of the character and variety of oxy-acetylene welding and cutting done at this plant may be gained from the following brief statement of work performed in ordinary plant operations: Building up worn spots on clam-shell buckets, pulleys, rollers, gears, shafting, keyways on shafts, motor-armatures, worn and stripped threads, wind-boxes on converters, tuyeres on converters, blast-furnace water-jackets, tuyeres in blast-furnace water-jackets; frogs, rails, and switch-points, and almost any worn or burned-out plate and cast-iron pieces; welding coal-dust cyclone collectors, coal-dust hoppers, conveyors and piping, reverberatory water-cooled slag-launder, calcine and flue-dust hoppers, dust and concentrate cars, matte and slag ladles; converter wind-boxes, tuyeres and roaster-gearing floors, hoppers, calcine-cars, centre-shafts, arms, concentrate cars, gears, shafting and all broken cast-iron parts; welding air-compressor parts; heating links on fly-wheels, welding intake and exhaust piping of air-receivers and coolers for from 42 oz. to 900 lb. per square inch pressure; welding water and steam pipe, Ys Ts, and Ls of most any shape; welding electric motor and generator housings, end-bells, bed-plates and gearing; starting-box and transformer oil-tanks and pipes, high amperage copper conductors and connections; welding machine-tool parts, heating shafts to straighten, gears to remove from shafting; roll-shells, and locomotive tires; welding locomotive frames, boilers, air-receivers, levers, links, and piping; cutting plates, angles, I-beams, channels, and rails; welding and brazing copper pipes, tanks, and bars, brass pipe tanks, bearings, and bars, bronze bearings, levers, bushings, shafting and pipes, aluminum bars, pipe, and plates.

Whenever changes and alterations in structural steel on erection or dismantling jobs in the field are necessary the oxy-acetylene torch is employed; particularly for making or filling rivet and bolt holes, and any other field work formerly done with hack-saws, chisels, and hammers.

Tapping of blast and reverberatory furnaces is done with oxy-acetylene equipment. Tuyeres and wind-boxes of converters are cleaned out by means of the oxy-acetylene torch.

From the foregoing it can be seen that the application of oxy-acetylene cutting and welding at Anaconda covers a wide range. New uses for this wonderful process are constantly being found. The process has demonstrated its worth as a saver of time and money, and it is difficult to understand why other metallurgical plants have not made as great use of it as has been done in Anaconda.

The Cause and Control of Lead Poisoning

By Wilbert S. Slemmons

For many years lead poisoning has been the most insidious and least understood of all the common industrial poisons. Protective measures, both State and Federal, have been enacted, outlining the responsibility of employers in protecting the health of their employees. Legislation or supervision of this type is not principally valuable in its aspect of force, its chief function being to outline the conditions unfavorable to workmen and to prescribe improvements. The employer usually welcomes such action, both from a standpoint of humanity and of collective efficiency.

In order to prevent industrial poisoning in a factory, four things must be known: the cause, the effect, a means of proving the presence or absence of the cause, and a method for effectually removing the cause. Too often has the effect of the poison been allowed to appear in order to make a diagnosis of the cause. A more noteworthy harm is the probable effect upon workmen whose symptoms do not indicate acute poisoning but who are in reality slowly absorbing the poison, being constantly exposed to its general debilitating effects. The branches of industry in which lead poisoning is most likely to occur include the following: smelters that handle lead ores, plants manufacturing or using lead products or alloys, those making lead colors or lead compounds, and where 'hot solder' is used extensively.

The gradual absorption of lead or lead compounds by the body is the invariable antecedent of lead poisoning. Such impurities, in a finely divided or gaseous state, may gain access to the body by any combination of three avenues: the skin, the respiratory system, the digestive or alimentary tract. Contamination through the skin may be occasioned by mere handling of lead or lead products with unprotected hands through a long period, or by general and continued bodily contact with lead dust or vapor. It can easily be seen how the vapor or dust of lead or of lead products finds its way into the lungs of workmen. Dust and vapor are sure to be given off to the surrounding air in any factory where lead or lead products are heated to a temperature approximating their melting-point. In a similar way any chemical processing of lead or lead products may give rise to fumes that carry a small amount of lead. These poisons are either taken directly into the lungs or find their way into the stomach, together with the downflow of nasal or pharyngeal secretions. Lead particles on the hands may be transmitted to food or to articles habitually placed in the mouth, and thus the poison is brought within the body.

It is almost certain that lead taken into the body in any manner is first converted to a lead salt before being absorbed by the body-fluids. The hydrochloric acid of the stomach would convert metallic lead or any of its oxides

into the partly soluble chloride, whereas metallic lead taken into the lungs would probably be absorbed slowly after being first changed to the carbonate or bi-carbonate.¹ If the intake rate to the lungs exceed the rate of absorption, the lead would lodge there, remaining as an anthracotic debris to hinder and diminish the normal respiratory exchange.

In order to appreciate the pathology and to interpret clearly the symptomatology of plumbism it is necessary to study the fate of ingested and absorbed material, paying particular attention to the course taken by soluble poisons, of which many of the salts of lead are good examples. Absorption takes place largely in the intestine, and for the most part in the small intestine. The villi or folds of the mucous lining of the small intestine are the diminutive organs of absorption, being supplied with both blood-vessels and lymph-canals or lacteals. Normal absorption is a process of diffusion of soluble-food units derived from ordinary food by the process of digestion. The tissue that lines the intestine exhibits a selective preference for these foods, and by diffusion admits them to the deeper cells of the villi where they meet the blood and lymph supply. From here the dissolved foods are conveyed to larger and more general channels of circulation. Although the lining of the intestine has a general selective preference for the diffusion of food substances, soluble poisons may gain access to the circulation along the paths followed by foods.

As vital evolution has ever been confronted with the impending danger of poisonous substance to the body mechanism, it has fashioned several organized tissues that have for their function the preclusion of possible toxic effects. Chief among these are the liver and the kidneys. The liver, in addition to its digestive and metabolic functions, can be considered an organ of de-toxification. Toxic substances dissolved in the blood-stream are, if possible, changed chemically by the liver-cells to non-toxic material. Normally the liver collects a number of the soluble waste-products of body metabolism from the blood-stream, and converts some of them to compounds less toxic and more easily eliminated. Likewise toxins liberated in the intestine by bacterial disintegration of proteins and absorbed by the circulation are de-toxified in the liver.

The kidney is the organ that is active in the removal of the soluble waste-products of metabolism from the blood stream. Nitrogenous substances such as urea and uric acid, formed in the liver from the units of food catabolism or tissue and food destruction, are removed in a soluble

¹Clifford, James O., 'Industrial Lead Poisoning', 'M. & S. P.', July 6, 1912.

state from the blood stream by the kidneys, and find exit from the body by way of the urinary tract. In consideration of the treatment of these physiological poisons it is highly probable, if not certain, that exogenous poisons would, if ingested and absorbed, take a similar course.

Exogenous poisons can be of two types, corrosive and alkaloidal, the latter being marked by specific action on the nervous system. Corrosive poisoning is a result of chemical change in tissue, one of the most common to which protein material is susceptible being that of coagulation. Soluble salts of heavy metals such as lead are uniformly poisonous to living tissue, their toxicity being regarded as a function of their protein coagulating properties. Examples of this type of poison are mercuric chloride (corrosive sublimate), silver nitrate (lunar caustic), and lead chloride. Lead chloride was particularly studied in this work on account of its importance in connection with lead poisoning. Metallic lead admitted to the digestive tract would be changed to the chloride. This salt is soluble in hot water and slightly soluble in cold water, a little more than a 1% concentration being maintainable at body temperature (which is about 37 C.). The coagulating effects of lead chloride solutions, in different dilutions, upon serum albumin, serum globulin, and soluble egg albumin were studied, and it was determined that lead chloride solutions possess measurable coagulating properties in a dilution of 1 part in 20,000. Assuming its toxicity to be relative to its protein coagulating properties, soluble lead chloride would be toxic to all tissue cells in this dilution, but would be particularly toxic to the more delicate tissues which it is assumed contain a more easily coagulable protein.

If lead chloride were absorbed, de-toxification would be attempted by the liver, and elimination by the kidneys. If these organs were subjected to contact with this poison, the functional capacities of their tissues would be diminished in proportion to the amount and persistence of the poison, which in turn would be directly proportional to the rate of ingestion of metallic lead. Degenerative changes in the liver and kidneys would naturally pre-dispose the subject to cirrhosis of the liver and interstitial nephritis, frequently the sequelae of plumbism. It is likely that the common symptoms of lead poisoning, such as general weakness and decline, abdominal pains, anemia, partial paralysis, convulsions, or headache, are due to general toxemia brought about by the impairing of the organs of de-toxification and elimination.

The pathology of the blood offers the best evidence as to lead poisoning. Blood smears are prepared for microscopic study as follows: a drop of blood is procured by piercing the finger-tip or ear-lobe of the suspected patient with a sterilized needle or lancet. The blood is smeared evenly over a glass slide by drawing the edge of a second slide across it at an angle of 45°. This is further prepared for examination by staining with diluted

Wright's blood stain, or other equally suitable stain. The red cells of normal blood appear as red discs, and the white cells or leucocytes as blue bodies containing a deeply stained nucleus. Blood of subjects suffering from lead poisoning shows the following characters microscopically:

1. Low red-blood cell count; varying from less than 2,000,000 to 1,000,000 cells per cubic millimetre of blood (the normal count being about 5,000,000 cells per cubic millimetre).

2. Low percentage of hemoglobin, which is the oxygen-carrying substance of the blood-cell and gives to it its red color (normal about 90%).

3. Poikilocytosis; characterized by non-uniformity in shape of the red-blood cells; they may be pear-shaped

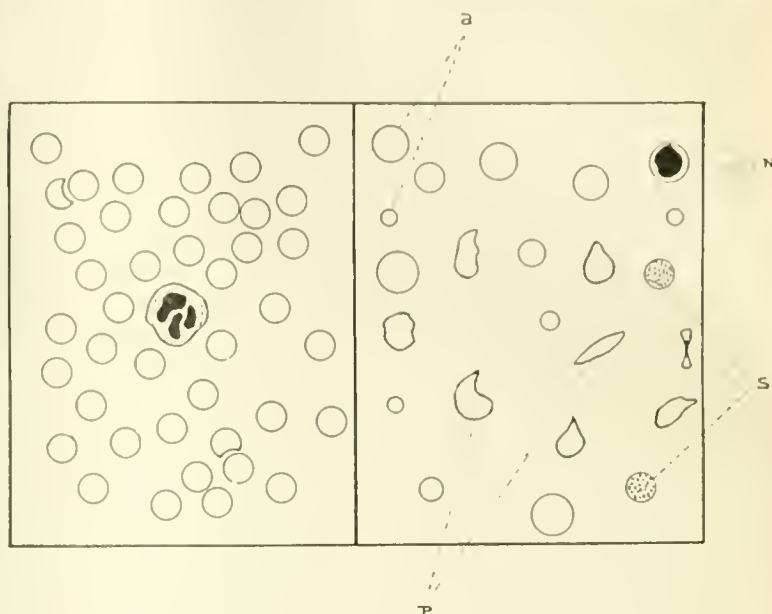


FIG. 1

FIG. 2

or lens-shaped, instead of uniformly round.

4. Anisocytosis; characterized by non-uniformity in size of the red-blood cells, that is, they may be larger and smaller than normal and may vary considerably in thickness.

5. The presence of normoblasts or megaloblasts; these are nucleated red-blood cells originating in the red bone-marrow and are not found normally in the blood. They are the embryonic or immature red-blood cells. It is due to the lack of an adequate supply of normal blood-cells that these are allowed to come into the blood-stream prematurely.

6. The presence of 'stippled' cells; these are red-blood cells undergoing 'basophilic' granular degeneration and can be distinctly associated with lead poisoning.² With the possible exception of pernicious anemia there is no condition other than lead poisoning in which the presence of 'stippled' cells is so constant.³

7. I have noticed a diminution in the number of blood

²Bulletin No. 100, Dept. of Labor, 'List of Industrial Poisons'.

³Simon, Chas. E., 'Clinical Diagnosis'; 1918, 694.

platelets and an increase in their size in cases of lead poisoning.

Fig. 1 shows the appearance of the blood-cells of a healthy individual. The cells are uniform in size and shape, occasional irregularities of the preparation being due to crowding or pressure. Fig. 2 shows the blood-cells of a patient suffering from acute plumbism. Note the fewer number of cells in the area as compared with Fig. 1. Poikilocytosis is illustrated by *p* and anisocytosis by *a*. Indicated by *n* is a normoblast or nucleated red-blood cell; the two dotted cells marked *s* are stiple cells.

Where lead, solder, or other lead alloys are used or processed at high temperatures, or where lead or lead compounds are handled so that the dust or vapor finds its way into the air in measurable quantities, the health and lives of workers are unquestionably endangered. In industrial plants of this nature the lead content of air can be estimated as follows: A measured volume of air is bubbled through two tubes of concentrated nitric acid.

of lead per cubic foot of air may be computed. Individuals developing acute plumbism, in my experience, had been working in an atmosphere that contained $\frac{1}{10}$ mg. of lead per cubic foot of air. In these instances the installation of a suitable rotary ventilator, which was piped to hoods covering the principal sources of air contamination, caused a marked diminution in the lead content of the air.

CONCLUSIONS. 1. Lead poisoning is caused by gradual absorption of metallic lead or lead compounds through the digestive tract, the respiratory tract, or the skin. It is probable that absorption of lead is more rapid by way of the respiratory and digestive tracts, and that the lead gains entrance to the blood-stream as the carbonate or chloride.

2. The effect of lead salts is largely that of impairing the function of the organs of de-toxification and elimination. The symptoms are due largely to general toxemia following the weakening of these tissues. The accumu-

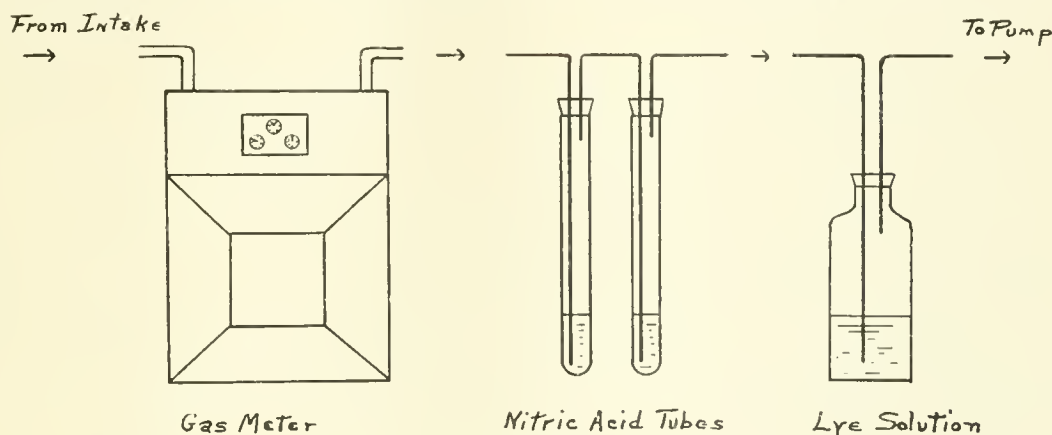


FIG. 3

The tubes should be large enough to prevent bubbling over of the acid. Measurement of the air is accomplished by means of an ordinary gas meter, and is drawn by a small vacuum-pump capable of exhausting 10 or 15 cu. ft. per hour. The air is first drawn through the gas meter and then through the two nitric-acid tubes connected in series. From here it is passed through a strong lye solution, to prevent injury to the vacuum-pump by the fume of nitric acid. Judgment should be used in placing the intake at a point where a representative sample of air is obtainable. A rough sketch of the apparatus is shown in Fig. 3.

The quantity of lead absorbed by the nitric acid may be determined by the usual method for lead estimations as lead sulphate, precipitation being accomplished by sulphuric acid.⁴ Care should be taken to use c. p. sulphuric acid, because the commercial variety contains lead in considerable quantity and acquired in the process of manufacture. This possibility of error may be obviated by accompanying the determination with a blank control. Having estimated the quantity of lead obtained and the volume of air used, the number of milligrammes

relative aspect of lead poisoning may be accounted for in this explanation, as the lead salts would not be readily eliminated following their combination with tissue protein.

3. Due to the relatively invariable occurrence in lead poisoning of the above-mentioned characters in blood pathology, the microscopical examination of blood 'smears' could be used to advantage in diagnosis or even for the purpose of detecting the development of lead poisoning in subjects.

4. Lead or lead compounds in factory air are dangerous to health. A quantitative estimation may be easily made; and if any measurable quantity of lead be detected, proper measures should be taken to prevent contamination. This might be accomplished by the use of ventilator hoods, or by other means applicable to the conditions.

AN American corporation has secured concessions from the Dutch and French governments for gold mining along the Maroni river, which is the boundary between Dutch and French Guiana, states a consular report. It is understood that the gold is to be recovered by dredging. A town is to be built, and a considerable personnel is now on the field with machinery and equipment.

⁴Talbot, Henry P., 'Quantitative Chemical Analysis', 1908, p. 58.

De-aeration of Cyanide Solution

By H. A. WHITE

*The amount of dissolved oxygen present in cyanide solutions may vary from 1 to 10 mg. per litre. In the following figures 6 mg. per litre is assumed to be present; the necessary correction must be made in any other case. This 6 mg. per litre is equivalent to 0.0006%, or 6 parts per million; or 0.012 lb. per ton of 2000 lb. The total gas dissolved in alkaline solutions will be about 2% by volume at normal temperature and pressure, and this would represent about 40% of the volume of the solution at an absolute pressure of 1.20 of an atmosphere.

For the purpose of removing oxygen from cyanide solutions before gold precipitation, the ideal chemical compound should fulfil the following conditions:

- (1) Low price and easy supply.
- (2) Insolubility after oxygen absorption.
- (3) Freedom from other undesired reactions.
- (4) Rapidity of reaction with oxygen.
- (5) Large capacity for oxygen absorption.

With reference to (1) it is obvious that a reagent which must remove 0.012 lb. of oxygen at a small cost per ton will have to be a chemical which is quoted at a price per ton, and not one like pyrogallol and other photographic developers, which are quoted at a price per ounce.

(2) Insolubility after the reaction would rule out hyposulphites which are sold under various trade names for use in the dye industry, even if the cost were not out of the question; they are, however, readily prepared from cheap materials, zinc and sulphur dioxide.

(3) Ferrous sulphate cannot be used in presence of cyanides even in dilute solution, owing to the well-known formation of ferrocyanide and the consequent destruction of cyanide.

(4) Sulphites and thiosulphates do not react with dissolved oxygen with anything like the required rapidity; and in the case of thiosulphates there is also an undesired (though very slow) reaction with cyanide to form thiocyanates. Sulphides are similarly ruled out, for, although the action is more rapid, yet the first product of the reaction is thiosulphate.

As sulphite and thiosulphate are actually present in small quantities in cyanide solutions that are at the same time nearly saturated with oxygen, a further investigation was considered unnecessary.

Experiments were made with tannin, wattle bark, wattle extract, manganese sulphate, ferrous sulphate, zinc, and aluminium. The results showed that, including the cost of lime and cyanide consumed by some of these de-aerators, the expense for the removal of 1 lb. of oxygen varied from 22.6d. to 186.4d. The conclusion was reached that none of the substances could compete with mechanical means, by which 1 lb. of oxygen can be removed from a solution containing 6 mg. per litre for a cost of 8.4 pence.

*Abstracted from 'Jour. Chem. Met. & Min. Soc. of South Africa'.

Chlorination of Natural Gas

The Bureau of Mines has recently issued a pamphlet* on the production of useful products by the chlorination of natural gas. Many natural gas fields in the United States yield gas that is free from the higher paraffins—propane, butane, and pentane—and is especially suitable for making chlorinated products. The gas from several of these fields, notably those in Louisiana, Texas, Wyoming, and California, where the wells are too remote from industrial centres and large cities to warrant the expense of piping, could be made into chlorinated products. The natural gas from fields near industrial centres can be disposed of to supply the industrial and domestic needs at relatively high returns, and in these fields it may be more profitable to use the gas in this manner than for making chlorinated products.

In the work covered by this report only the so-called 'dry gases' were investigated. The 'wet gases' from wells situated in isolated places are utilized at present for obtaining gasoline by treating them either by the compression or the absorption method. Certain chlorinated products might be profitably manufactured from the 'wet gas' after the gasoline is recovered. On the other hand, the 'dry gases', consisting chiefly of methane and at times small portions of ethane, are of no value for gasoline production. Such gas offers possibilities for the production of methyl chloride, chloroform, and carbon tetrachloride.

The work described in this report was confined to the effect of different catalyzers on the chlorinating reaction; also the effect of temperature and, to a smaller extent, that of water vapor were observed. As many variables enter into the reaction, all conditions were kept as constant as possible and variations made only by changing catalyzers, temperature, and water-vapor content. No attempt was made to study the effect of pressure and reaction velocity.

The tests were run at such a rate of gas flow that the temperature could be accurately controlled and the heat of reaction taken care of by radiation and by the heat required to heat up the inflowing gases. At higher rates of gas flow the large amount of heat produced would necessitate removal by artificial methods. Work now in progress indicates that this can be accomplished by introducing some of the chlorinated products along with the gases, thus keeping down the temperature by the heat capacity of the inert gasified liquids, or can be brought about by the use of cooling coils around the catalyzer.

Of the many natural-gas fields yielding gas which contains methane as the only combustible constituent, the Caddo field of Louisiana is the most important. This field is situated in Caddo and De Soto parishes; it supplies gas to a great many towns to the north as far as Little Rock and Pine Bluff, Arkansas. The average analysis of the gas from this field varies from 95 to 99% methane, with a small proportion of carbon dioxide and nitrogen.

*Tech. paper 225, Pet. Tech. 63.

REVIEW OF MINING

FURTHER CURTAILMENT IN COPPER PRODUCTION

The extent of the curtailment in refined-copper production is indicated by the fact that a group of 18 important producers turned out 23% less copper during the first two months of this year than during the corresponding period of 1920, while there was a drop of 25% as compared with the first two months of 1919.

The porphyries as a group accounted for 55,184,000 lb. during the two months, against 69,801,000 lb. during the first two months of 1920, a decrease of 14,617,000 lb. The Calumet & Hecla companies turned out but 11,629,384 lb. this year, against 18,349,123 lb. during the same period last year and 22,023,268 lb. during the first two months of 1919. But three of this group are now producing.

The following compares the refined-copper production of these companies during the first two months of the past three years, the figures being in pounds:

	1921	1920	1919
Ahmeek	3,682,200	3,017,500	3,631,639
Anaconda	18,700,000	36,600,000	28,300,000
Arizona	4,300,000	6,000,000	6,600,000
Calumet & Arizona	5,768,000	7,188,000	5,156,000
Calumet & Hecla..	9,343,184	10,413,543	11,084,038
Chino	5,989,685	6,258,426	7,793,676
East Butte	3,134,060	3,199,000	2,925,510
Inspiration	9,500,000	14,400,000	13,100,000
Isle Royale	1,604,000	1,987,094	2,658,135
Miami	8,590,094	8,550,767	9,735,838
Nevada Con.	6,000,000	8,031,000	8,550,000
New Cornelia	4,145,918	6,872,000	9,346,000
North Butte	879,231	3,708,569	3,279,591
Old Dominion	4,704,000	4,607,900	5,172,000
Phelps Dodge	16,283,000	15,547,000	21,063,733
Ray	5,959,000	7,784,073	8,620,000
United Verde Ext..	6,569,854	6,654,210	5,284,508
Utah	15,000,000	17,905,395	20,835,000
Total	130,152,226	168,724,477	173,135,668

CALUMET & HECLA CUTS THE KEARSARGE AMYGDALOID LODE

It was officially confirmed last week that Calumet & Hecla had cut the Kearsarge amygdaloid lode in a cross-cut east from the 81st level of the Red Jacket shaft. It is declared to be rich at the point penetrated. The vein, measuring by surface distance, is a half-mile from the Calumet conglomerate, but owing to the dip of the lode and the fact that the Red Jacket shaft is vertical, this distance was shortened at depth and it was necessary to cross-cut but a quarter of a mile. The importance of this strike to the future of Calumet & Hecla can scarcely be over-estimated. If it continues to open up as at present and the vein is found to be of uniform value at this point it will give Calumet & Hecla another large mine. The Kearsarge is the master amygdaloid lode of the district and some of the most productive mines were located on it. Ahmeek, one of the richest properties in this region and a subsidiary of Calumet & Hecla, is on this lode. Whether the vein will be worked from the new Calumet & Hecla haulage-way on the

81st level of the conglomerate shafts or from surface remains to be determined. All exploratory work, however, will be done from the haulage-level. It may be more feasible to mine the lode from this level, hoisting the rock through the Red Jacket shaft. In the event this can be done, the heavy expense of sinking a new shaft will be avoided.

TARIFF ON MERCURY SOUGHT BY NEW IDRIA CO.

The report of H. P. Baker, general manager for the New Idria Quicksilver Mining Co., just issued comments on the present status of the quicksilver mining industry as follows: "In order to protect the industry from the indiscriminate dumping of foreign quicksilver, the general manager of the company has appeared before the Committee on Ways and Means at Washington in support of a tariff of 50c. per pound on quicksilver; and, in view of the absolute necessity for quicksilver, both in peace and war times, it is hoped that the Government will accede tariff protection in order to foster a highly important industry. The low price of quicksilver prevailing since September was caused by the dumping of large quantities of foreign quicksilver from Europe, over 16,000 flasks having been imported in 1920, against a normal import of 6000 flasks. Some of this imported quicksilver has been sold as low as \$35 per flask. Prices were influenced by the low rate of London and Italian exchange, which enabled foreign producers to obtain a relatively high price for their product in this country. These large importations, and low prices which are much below the cost of American production, demoralized the home market, and resulted in closing down not only our own mine but nearly every other quicksilver property in the United States."

BUTTE MINE OPERATORS GIVE ULTIMATUM TO LABOR UNIONS

Mine operators of the Butte district, at the conclusion of conferences with representatives of the metal crafts and other trades, have announced new working rules and regulations. Working conditions are changed drastically, and many jurisdictional questions which long have been regarded as a burden by the operators and have involved the companies and the various crafts in numerous disputes have been disposed of. The operators announce that all unions must waive all rights and claims to 'seniority'. This demand is expected to occasion much debate among the unions and may cause a split in their ranks. If organized labor stands upon its previous declarations, it probably will mean an 'open shop' in the Butte district, and the operators will permit the situation to work itself out, if the unions do not accept the changes proposed. For the first time in years the operators stand in an expressed attitude that if they are going to split with the unions it will be a split for good.

ALUMINUM DURING 1920

The value of primary aluminum produced in the United States in 1920, according to reports received by the U. S. Geological Survey, was \$41,375,000, as compared with \$38,558,000 in 1919. This increase of approximately 7% shows a return to more normal operations and indicates what may be expected in the future. Market prices throughout the

year have been nearly constant, ranging from 32 to 33c per pound.

FEBRUARY PRODUCTION ON THE RAND

The output of gold from the mines of the Rand during February were 588,127 oz. compared with 651,093 oz. in January and with 625,130 oz. in February last year.

ALASKA

Hyder.—J. W. Marr and Emil Davis will drive a 200-ft. drift to tap an orebody on the Commonwealth group of claims.

Juneau.—The Falcon Mining Co., Elmer Strom, superintendent, is driving a tunnel on its property at Falcon Arm, Chichagof Island. A lode of rich gold ore has been developed extensively on the surface. The erection of a mill is planned. Silver-lead ore worth \$200 per ton has been found on the Ruby property in the Kantishna district. The property is being developed by Tom Altken. At the Silver King property in the Wild River district good galena ore containing some silver is being developed.

ARIZONA

Bisbee.—The annual report of the Shattuck-Arizona Copper Co. for the year 1920 shows a net loss for the year of \$259,117. The report recites in part: "We have blocked-out ready for stoping more than 15,000 tons of ore, which will assay 7½% copper and 6 oz. silver per ton. More ore is indicated but not blocked-out yet." The value of the mining property with depletion reserve deducted is placed at \$5,827,373, and that of the buildings, plant, and equipment, with depreciation reserve deducted, at \$234,804, or a total of \$6,062,178. The report shows that since July 20, 1910, the company has paid in dividends a total of \$7,612,500.

A large body of oxide ore has been developed on the 100 and 200-ft. levels of the Higgins mine. The body is about 100 ft. wide by 350 ft. long, and has been explored for some distance above the 100 and down to the 200-ft. level. The average for one year of blocking-out operations, which consisted of raises and cross-cuts on both levels, gave smelter returns of 7½% copper.

Humboldt.—G. M. Colvocoresses, general manager for the Consolidated Arizona Smelting Co., in discussing the affairs of the company, is quoted as saying: "The company, from the first of 1915 until the end of 1919, produced 34,000,000 lb. of copper from its own mines, the Blue Bell and the De Soto, and the net cost of production, after crediting gold and silver, was 15c. per pound. The earnings of the company, beginning with 1915, were used, first, to pay a part of the debt and to replace and rebuild the plant, for which latter purpose \$1,800,000 was required; also, dividends were paid, all from earnings; but, unfortunately, the company never did get out of debt, and when the Government returned about six million pounds of copper at the end of 1918 (some of which was custom copper purchased on the basis of 26c. per pound), the subsequent forced sale of this material at the low prices of the spring of 1919 reduced its value by approximately \$500,000. I still believe that if this company can be reorganized on a sound financial basis, free from debt, and with proper funds provided for working capital and for mine development, it can continue to produce its own copper with profit for a number of years, and, although I agree that there is no chance for custom business with 12c. or even with 15c. copper, I am convinced that before the price returns to 20c. many other properties will open up, and that our custom business can again be made as extensive and profitable as it was during the last five years."

Kingman.—It is reported that high-grade ore has been opened in both the east and west drifts on the 400-ft. level of the C. O. D. mine. The ore in the east drift is said to assay 310 oz. silver and \$16 gold per ton over a width of

20 in. In the face of the west drift the ore opened is also high grade. Sinking below the 400-ft. level is now in progress, and as soon as the present development work on the 400-ft. level is completed a new three-compartment working shaft is to be sunk. The new 125-ton mill is expected to be in regular operation during the latter part of the month. The C. O. D. mine is situated in the Stockton Hill district 12 miles north of Kingman.

The Rico property, which adjoins the C. O. D. mine on the west, has been optioned to L. C. Bateman and San Francisco associates. This property is situated on the strike of the C. O. D. vein and is a silver producer. Development is to be started immediately. The Tyler group of twelve claims, which adjoins the C. O. D. mine on the north-west, has been bonded to St. Louis interests. There is reported to be a large developed tonnage of good silver ore in the mine. Work will commence at once.

The White Hills group of claims is being subdivided into leasing tracts. Three leases have been let. One lessee reports the opening of ore that runs \$160 per ton. The shaft of the G. A. R. claim is being unwatered by the company. The Occident and Norma claims are to be worked and are expected to produce sufficient ore for the mill, which is practically ready for operation. These mines, which are about 80 miles north of Kingman, are but a short distance from the proposed Boulder Canyon dam-site.

Mayer.—At the Gloriana mine, owned by Andrew Smith and George A. Lane, a modern milling plant is being erected. The property is three miles south of Humblebee, where gold ore sufficient to run the mill for a year has been blocked-out.

A mill is to be erected on the Gillespie property, owned by the Arizona Copper & Mining Co., for which Samuel Hobson, of Mayer, is manager. The plant should be completed by May 1.

Ray.—The Ray Hercules Copper Co. is to issue \$3,000,000 of 8% seven-year convertible collateral trust bonds, reduce the par value of its stock from \$5 to \$1, and increase the number of shares from 1,500,000 to 4,000,000. It is planned to exchange the present stock share-for-share for the new issue, and place the remaining 3,000,000 shares in the treasury.

Tombstone.—A test-run on the new plant of the National Metals Recovery Co. is being made. Additions and alterations will permit the treatment of 100 tons per day. Machinery is being installed in the new plant of the Tombstone Co-operative Milling Co. on the site of the old Fisher mill. It should be ready for operation by April 15.

CALIFORNIA

Colfax.—The Rising Sun mine, closed down for 33 years on account of litigation, is now producing high-grade ore from the 600-ft. level. Following an examination last week by Harry Hertzberg, of New York, it was decided to sink the main three-compartment shaft from the 900 to the 1400-ft. level. Government statistics indicate an output of \$2,000,000 prior to 1885.

Grass Valley.—The Grass Valley Consolidated Mines Co., operating the Allison Ranch mine, has secured working-options on a large area south of the property. It will be thoroughly explored.

It is reported that miners who worked in the mines 30 years ago will be employed to direct some of the work being done by the Idaho-Maryland company. It is thought that their personal recollection of early operations will be of value in tracing the old high-grade ore-shoots. Operators on the Alcalde group of claims are said to have found substantial shoots of new ore. Additions to the mill are planned.

Jamestown.—San Francisco capitalists have taken a bond on the Alameda and Crystalline properties. The sinking of a deep shaft is the first step in plans for development.

Knabe.—Seven prospectors are said to be making good wages panning on Beegum creek. Gold, platinum, and iridium are recovered. One miner recently sold 36 dwt. of platinum.

Redding.—The Mountain Copper Co. has decided to abandon the Iron Mountain mine. Headquarters will be moved to the Hornet mine, two miles away, and the only persons left in the famous old copper settlement will be the watchmen. The Iron Mountain was shut-down two years ago, owing to the depression in the market for copper, but since then the mine has been kept unwatered and underground repairs were made so the mine could resume operations at any time. Hope of an improvement in the market has been abandoned. The pumps have been withdrawn from the mine, all pipes removed and tracks taken up. The company will continue the shipment of pyrite ore from the Hornet mine to chemical works on the bay, where the ore is utilized in the manufacture of sulphuric acid.

The Utah-California Gold Mining Co., controlled by Salt Lake City capitalists, is preparing for active work on its recently purchased holdings near Callahan. The property includes the Oro Grande, Drummond, Buzz Saw, Summit, Boulder, and other claims, and 500 in. of water from Boulder creek, together with mine-plant, power-plant, sawmill, and other equipment. Many of the claims have yielded considerable gold.

COLORADO

Durango.—Reports from the La Platas indicate that active development will be done this season. The American Smelting & Refining Co. has recently acquired a promising silver property and a mill is planned, construction to start as soon as the conditions of the roads permits.—The Jumbo and Idaho mines are operating and the Jumbo will soon be shipping heavily from ore-reserves developed during the winter.—The Cave Basin group operated during the winter months, and shipments from orebodies developed on new veins will start shortly. The old Neglected mine, with production exceeding \$250,000, is to resume, as soon as the workings are unwatered.

Idaho Springs.—Operations were resumed March 14 by the Silver Gem company and as soon as preparatory timbering and cleaning up is completed the force will be increased and shipments from orebodies opened prior to the shut-down will follow. The Silver Gem ore, as shown by settlement sheets, ranges from 52 to as high as 518 oz. silver per ton. Three distinct orebodies await development.

Leadville.—In spite of the condition of the metal markets steady shipments are being made to the smelters. The gold content of the ore makes it profitable to ship lead and zinc ores.—The Griffin mine in the St. Kevin district is being developed from two 1000-ft. adits. In the upper a body of zinc ore, containing a streak of high-grade silver, is furnishing shipping-ore.—The Western Zinc Oxide Co. is operating the old unit at capacity and is finding a ready market for its product. The company recently installed a Reel Bolting unit consisting of a 'silo' cylinder screen with screw-conveyor and a Grout feeder. This new machinery will add to the uniformity of the product and will also reduce the amount of re-treatment oxide. When the market improves it is the intention of the company to start the new unit which will double the capacity of the plant.

Ouray.—A mineralized vein, five feet wide, has been cut on the Uncompahgre canyon property of the Eurades Mining Co., containing good silver-lead ore, samples of which average \$40 per ton. The find was made in undeveloped territory with 500 ft. of virgin ground above. The company has employed 20 miners all winter and is now increasing this force.—The Chipeta M. M. & S. Co. is building a power-line to the H. A. C. property.

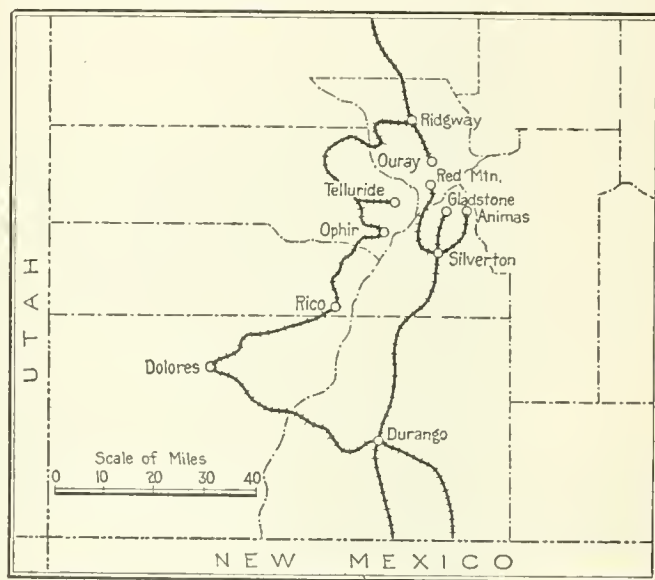
Telluride.—Shipments of concentrates from the mines of

Telluride for the month of February were as follows: Smuggler-Union, 46 cars; Tomboy, 43; Liberty Bell, 15; total, 104 cars. During February 1920, 110 cars were shipped.

—The Matterhorn mill of the Valley View Leasing & Mining Co., is running full time and making about 12 cars of concentrates per month. For a time the company was handicapped by freezing of water pipes at a point where they crossed the railway track.

IDAHO

Coeur d'Alene.—Two feet of good milling ore has been cut in the east drift of the Chicago-Boston mine. The management has gone back from the face of the tunnel to the point under the good orebody shown on the 200-ft. level and has commenced a raise to find the orebody above.—New machinery will be installed by the American Commander Mining Co., which operates the First Thought mine. The machinery includes a compressor, motors, transformer, and machine-drills. The cost will be between \$5000 and \$6000. Two shifts are being worked.—Lessees at the Western



South-Western Colorado

Union mine are loading a car of ore for shipment to the East Helena smelter. This will be the 12th car shipped this year. The ore has now been stoped 75 ft. above the main-tunnel level.

The Caribou Mining Co. has called for bids on a contract to drive 100 ft. in tunnel No. 3. The tunnel now has a depth of 150 ft., and when the work is completed will have a depth of 250 ft. The two veins should converge at this depth.—James F. McCarthy, manager of the Hecla mine, says: "Development of the 2000-ft. level during the year advanced the drift 842 ft., with the face still in good ore. The result of this work has been gratifying. The ore is good and the vein of more than average width. Our ore-reserves are estimated at 2,095,745 tons."

Mackay.—Increased production from the Empire Copper mine has followed a change of management the first of the year. The number of lessees has increased from 12 to 30 and shipments are being made to the Utah smelters at the rate of 15 cars per month. There are now 75 men in the company's employ.

MICHIGAN

Calumet & Hecla's February production was 4,671,984 lb. refined; Ahmeek, 1,863,900; and Isle Royale, 859,200. For Calumet & Hecla the output was just 784 lb. more than for January; Ahmeek produced 45,600 lb. more than the preceding month; and Isle Royale 13,400 lb. more.

There is an actual shortage of miners in the Lake Superior copper region, particularly in the southern part. Difficulty is being experienced, even on the basis of curtailment, in keeping forces up to the required number. This is the time of the year when some of the underground men are leaving for the farms and the mines are finding it hard to fill their places. Positions are open for a limited number of miners at both the Quincy and Copper Range mines. A few men are coming back from the automotive centres, and Quincy is taking on as many of these as have had underground experience. The Copper Range continues to get a few men from the Iron districts.

Arcadian Consolidated has started its drift from the 942-ft. level of the New Baltic shaft south toward the New Arcadian shaft, with which it will connect at the 900-ft. level. A north drift also has been started to test out the ground. This drift will be driven about 200 ft. A station for the handling of rails and timber has been completed. As the south drift proceeds it will be widened the width of the vein wherever the ground warrants stopping. The north drift from the 900-ft. level of New Arcadian extends for 1000 ft. toward New Baltic, and later in the spring it is proposed to proceed with this drift. This will reduce the time required to connect the shafts, the intervening distance being 2500 ft. The character of the ground in both shafts is identical, which strengthens the hope that the vein between the shafts will be productive.

Until Seneca installs its new hoist it will proceed more leisurely with the opening of new ground and sinking operations. The present hoist is capable of carrying the shaft down ten levels, but it is believed the new equipment will be in place before that depth is reached. The shaft is now bottomed at the 6th. The cross-cut to the hanging-wall side of the lode at this point is about completed and preparations are under way for drifting both north and south.

MONTANA

Butte.—The Shannon mine of the Barnes-King Development Co. was the only producer in the company's group during February. The mine produced 2753 tons of ore assaying \$7.48 per ton, which resulted in a return of \$22,530. During the month the raise to the surface of the Black Hawk was holed-through, and a shaft-house and head-frame used at the Rosebud shaft were moved over the completed raise. The raise will now be enlarged and timbered as a permanent shaft.

Elkhorn.—John D. Pope, general manager for the Boston & Montana Development Co., is blocking out ore in the Idanha vein. Recent assays show from 24 to 47 oz. of silver; $2\frac{1}{2}$ to 8% copper; 4 to 15% lead; and 50c. to \$4 in gold. The 750-ton concentration-flotation plant building has been completed. Setting of machinery is now in progress.

Elliston.—The Evening Star Development Co. is shipping ore from the Big Dick mine; 200 tons of high-grade ore is ready for shipment. According to Howard Cooney, an official of the company, the ore averages 100 oz. silver, 2 oz. gold, and 35% lead. Bunk-houses are being built for 50 men.

NEVADA

Divide.—The Divide Extension has started shipping ore from above the 200-ft. level, where the company is reported to have opened an orebody 120 ft. long and 4 to 10 ft. wide. There is said to be \$100,000 worth of ore exposed as a result of work during the last three months to solve the problem of a fault between the 100 and 200-ft. levels. Shipments are being made to the MacNamara mill at Tonopah at a rate of 20 tons daily under a contract with the mill to treat this tonnage.

Goldfield.—It is estimated that 150 men are working in the mines of the Goldfield district, which includes men leasing. Fifty are working in the Consolidated and 28 in the

Florence. Five carloads of medium-grade ore have been shipped recently by Consolidated lessees, including two from the Silver Pick. A L. Sailors, of Los Angeles, one of the financial backers of the Goldfield Quartz Mountain Co., has financed a lease on the White Rock, where no work has been done for many years. The block includes part of the White Horse and Blue Jay claims of the White Rock and 600 by 300 ft. on the February claim of the Consolidated. A 330-ft. shaft will be equipped with electrically driven hoisting machinery and work will be started at the bottom. Two Goldfield miners associated with Sailors took the lease after they had found that the dump assayed \$6 and that 10 tons of ore assayed 1 oz. gold, 4 to 5 oz. silver, and 2 to 3% copper. Sinking of the shaft was started in 1905 and, being dry, it is now in fair condition. It enters the sulphide zone at 200 ft. and at the bottom there is a 70-ft. cross-cut that enters the vein.

Hornsilver.—J. W. Dunfee is preparing to start shipping \$25 to \$30 ore from the find made recently by him on the 580-ft. level of the Orleans mine. He will ship through Stonewall Sliding, 16 miles distant, and the profit on \$25 ore will be \$7 to \$7.50, he estimates.

Klondyke.—The Knox is now shipping at a rate of 35 to 40 tons daily, most of the ore coming from the stope above the 60-ft. level, where it is being broken over a length of 60 ft. and a width of 11 ft. The Ben Hur is employing 20 men, including six miners, on claims adjoining the Original Klondyke and a block leased from that company. Work is to be done through two shafts.

Mina.—Mining men in Mineral county are pleased with the passage of a bill authorizing the Board of Commissioners of the county to issue bonds to the extent of \$150,000 for the purpose of extending the power-transmission lines of the Nevada-California Power Co. to Hawthorne, Luning, Mina, Union, and other points. Hitherto the lack of adequate power has been a decided handicap to the development of the mineral resources of the adjacent territory.

Whiting Bros. & Mosler, who have been mining cinnabar on the Last Steer group of claims, recently shipped their 34th flask of mercury. The ore occurs in regular seams of altered limestone and in places averages fully 5% over a width of 28 in. Present plans are to install battery of 'D' retorts to treat the rich ore in shoot No. 1 and later install Scott or rotary furnaces. The property lies 13 miles east of Mina and is reached by good roads. It has sufficient water for operation.

Pioche.—W. E. Brody and J. E. Nagel, lessees of the Amalgamated slag-dumps at the old Pioche smelter, have shipped three cars of slag. The presence of considerable arsenic, which is now selling at a good price, increases the value of the slag. Silver-lead ore is being mined and stored on the Currency lease.

Tonopah.—The annual report of the Tonopah Mining Co. shows liquid assets and cash on hand of \$4,642,131. Net earnings and income for 1920 were \$410,399. Receipts for the year were \$1,577,430 and the disbursements amounted to \$1,560,455. The report of H. A. Johnson, mine and mill superintendent, says that on December 31 there was enough ore in sight for a production of 150 tons daily for four months. The production during the year was 56,587 dry tons of \$16.93 ore, on which the profit was \$4.22 per ton, or a total of \$238,922.92. Mining costs were \$5.045 per ton as compared with \$6.37 in 1919.

OREGON

Gold Hill.—The outlook for gold mining is more favorable than at any time since 1914. The only quartz mines in operation in southern Oregon at present are the Sylvanite group, the Millionaire, and the Gold Ridge, all within a radius of three miles from Gold Hill. A number of the old producers, including the Ashland, Opp, Braden, Bill Nye,

Greenback, Alameda, and many smaller properties, have been kept in repair with a view to resuming operation. Many of these will resume with the dropping of the price of mining machinery, supplies, and labor.

In spite of the falling price of quicksilver there is activity in the development of cinnabar deposits in southern Oregon and in Siskiyou county, California. The War Eagle Mining Co., operating the Utah group of mercury mines 12 miles north of Gold Hill, has operated steadily since the War. It has a full crew in the mine and is reducing the ore with a 25-ton Scott furnace and is also operating several units of 12-pipe mercury furnaces on rich ore. The Chisholm and Force groups, adjoining mines, are being developed. Each has furnaces for reducing the ores.

The Blue Ledge and the Queen of the Bronz, copper mines that suspended shipping of ore during the winter months, are preparing to resume shipments to the Tacoma smelter. During the shipping season the Blue Ledge's

years this is the first one that did not find water above the 700-ft. level.

UTAH

Alta.—A raise from the Illinois tunnel at the Emma Silver property has cut a streak of high-grade ore. Recent assays give returns of 50 oz. silver and 63% lead.

Cisco.—The Utah Placer Mining Co., H. J. Butcher, secretary-treasurer, has 800 acres of promising placer ground on the Grand river just below the mouth of the Delores. Besides gold, the gravel is said to contain some platinum.

Eureka.—Ore shipments for the week ended March 18 are as follows: Tintic Standard, 55 cars; Chief Consolidated, 29; Dragon, 18; Iron King, 16; Eagle and Blue Bell, 10; Iron Blossom, 6; Victoria, 5; Grand Central, 3; Gold Chain, 3; Bullion-Beck, 3; Colorado, 2; Ridge and Valley, 1; Gemini, 1; Alaska, 1; Swansea, 1; Sunbeam, 1; total, 155 cars.—The Tintic Standard Mining Co. has declared a



Old Channel Placer Mine, Josephine County, Oregon

shipment averages 200 tons weekly of ore averaging 12% copper. It is an excellent flux for the Alaskan copper ores. The Blue Ledge company is planning an electric power-plant at a cost of \$50,000. The proposed plant will be situated at Seattle Bar on Elliott creek, eight miles from the mine, and will develop 200 hp. At this point the water will have a drop of 200 ft. The plant will double the present output of the mine.

TEXAS

Spearman.—While drilling a test-well for oil, upon the Turkey Track ranch near here, W. Scott Heywood and associates discovered a deposit of salt 111 ft. thick. This salt stratum was penetrated at a depth of 700 ft.; a remarkable thing about it is that not a drop of water was found while drilling the hole. Neither has there been any water found anywhere else in the well, which is now at a depth of more than 2700 ft. The fact that there is no water above the salt-bed makes the mining possible. Mr. Heywood says that in event oil is not struck in the well he will take steps to mine the salt. Of the many wells that have been drilled in the Panhandle of Texas in search of oil during the last two

quarterly dividend of five cents per share instead of the usual ten-cent distribution. The precarious condition of the metal market is assigned as the reason. With this payment on April 2 the total dividends will amount to \$1,479,597.

Shipments of silicious ore have been curtailed by the Eagle & Blue Bell and Victoria mines, and as a result, about 50 men have been laid off. Ordinarily about 130 men are employed in the two properties, and the force has been cut to between 80 and 90, and shipments of this kind of ore cut to 50 tons per day. Some of the highest-grade lead ore ever found in this district is exposed in the stopes at the Eagle & Blue Bell mine.—At the Little May property, in the southern end of the district, about 10 ft. of ore has been opened up on the 200-ft. level, which averages 3.2 oz. silver and 2.2% copper per ton. This mineralization is taken as a favorable indication that at depth a higher-grade orebody may be found. The ore contains 36% sulphur and 28% iron.

Logan.—The Utah Standard Mining Co. has been organized to acquire mining property about three miles east of Hyde Park and six miles from this city. Rich float has been found in Dry Hollow. Some months ago, several residents

of Hyde Park did exploratory work, with the result that a lode 60 ft wide was discovered. The gangue material of the vein is stained with manganese and iron. Irregular shaped pieces of galena have been found near the surface, some of which assay as high as \$8.40 in gold, \$67 in silver, and 33.3% lead. H. C. Hansen, manager for the company, states that a compressor and hoisting-plant will be installed as soon as they can be delivered.

Park City.—A slight increase in ore shipments is recorded for the week ending March 18, the total being 1864 tons divided as follows: Judge Allied companies, 832 tons of ore and 15 tons of 'premium' spelter; Silver King Coalition, 476 tons; Ontario, 431 tons; Nalldriver, 110 tons.

Salt Lake City.—At the annual meeting of the Utah Chapter of the American Mining Congress on March 14, eight of the twenty-four directors, whose terms had expired, were re-elected: C. E. Allen, Ernest Hamberger, Fred Cowans, R. C. Gemmell, G. W. Lambourne, Duncan MacViehle, E. J. Raddatz, and V. S. Rood. L. S. Cates and M. R. Evans were elected to fill vacancies on the directorate. After the membership meeting adjourned, the directors met and elected the following officers for the ensuing year: G. W. Lambourne, governor; Walter Fitch, first vice-governor; C. E. Allen, second vice-governor; J. Will Knight, third vice-governor; A. G. Mackenzie, secretary and treasurer.

At a meeting of metal-mine operators of the State on March 17, it was decided to make a reduction of 25c. per shift in the wages of underground employees, effective April 1. When wages were reduced on January 1, the underground miners were decreased 75c. per shift, whereas in practically all of the other mining camps in the West, the reduction was \$1 per shift. The new rates for timber-men and machine-men will be \$4.25; helpers, \$4; muckers, \$3.75. No reduction will be made at the Utah Copper mine, as skilled employees were reduced \$1 per shift and unskilled labor 85c. per shift on January 1.

WASHINGTON

Spokane.—The directors of the Northwestern Iron & Steel Co., recently organized, have decided to start a campaign to raise \$50,000 for the erection of their first blast-furnace. The proposed furnace will be at its property on Deep lake, nine miles from Boundary, and near Leadpoint. The company has taken 60 acres of timber land one mile from the property, and will use the timber for making charcoal for use in the furnace. The company owns 300 acres of iron-bearing property along Republican creek.

It is reported that the new plant at the Pyrrargyrite mine, a short distance west of Nighthawk, has started and is making a good concentrate. The mine was formerly known as the Ruby, one of the oldest developed properties in the northern part of the county. The mill, constructed last winter, runs by electric power, supplied by the Okanogan Valley Power Co., which has completed a big dam at the falls of the Similkameen.

BRITISH COLUMBIA

Golden.—The Bunyan Silver-Lead mine is to be opened in the spring; from 100 to 125 men will start work as soon as weather permits.

Hartley Bay.—The Drum Lummen mine will be re-opened, according to reports. Additional finances to the extent of \$200,000 are available in New York, most of which is to be expended in providing a mill and adding new equipment. Glenville A. Collins, who is in charge, has left for the East on this business.

Prince Rupert.—R. W. Racey, consulting engineer for the Alice Arm Holdings Co., recently paid a visit to the company's Bellevue mine, on the Illiance river. The orebody is 40 ft. wide and contains a number of veins from a fraction of an inch up to 8 ft. thick. Some of the small stringers are

exceedingly rich, being composed of almost clean galena and zinc blende and carrying up to 150 oz. in silver and \$2.20 in gold per ton. The orebody has been traced for 3500 ft. The company hopes to mill profitably the whole orebody. R. G. E. Leckie has bonded the Columbia and Excelsior & Eagle groups, on Glacier creek, 8 miles from Stewart. The terms of the bond call for considerable development work, which will be superintended by W. W. Rush, one of the owners of the property. A. A. McPhall, an oil expert, has been making a series of extraction-tests on the oil-shales on Graham Island.

Princeton.—It is rumored that the Canada Copper Corporation's mine, at Copper Mountain, and plant, at Allenby, are to be re-opened. The Kettle River Railway and the West Kootenay Light & Power Co., both of which are closely associated with C. P. R. interests, have large sums of money tied up in the railway and power-line to the Canada company's mine and mill. The Consolidated Mining & Smelting Co., another subsidiary of the C. P. R., needs copper ore for its blast-furnace, refinery, and rod-mill, and arrangements may be made by which the mine will be operated by the Consolidated company.

Trail.—Ore-receipts at the Trail smelter of the Canadian Consolidated Mining & Smelting Co. for the last week of February were 8031 tons, exclusively from the company's mines. This brings the total receipts at the smelter for the first two months of the current year to 66,211 tons, over 11,000 tons greater than for the corresponding period last year.

MEXICO

Campas.—O. L. Near has resumed work at his Cerro Gordo mine, 45 miles west of here. Mr. Near shipped good ore prior to 1910, when the mine shut-down on account of the revolution.

Monterrey.—Most of the mines in the districts of Durango and Coahuila from which the smelter of the American Smelting & Refining Co. at Asarco, in the Velardena district draws its ore supply, have closed down, throwing several thousand laborers out of employment. While the smelter is still operating, it is stated that it is facing a shortage of fuel, and this fact, together with the cutting off of its ore supply, may cause it to suspend operations soon. The smelter still has a considerable supply of high-grade ore on hand.

John P. Flynn, a veteran American mining man, who has been operating mines in Mexico for many years, has filed on several groups of rich claims in the Avino district, State of Durango. This district has yielded much rich gold, silver, and copper ore.—James Haag, of Durango, is preparing to develop a group of claims in the Palomas mountains, near Cantalan, State of Durango.

Development of La Laga group of silver mines at Concepcion del Oro, State of Zacatecas, will be started soon by G. P. Stocker, of San Antonio, Texas, and J. L. Howell, of Fort Worth, who recently purchased the property. It is stated that new machinery and equipment will be installed and that the output will be increased. The property already has a notable record for production of silver ore. Mr. Stocker was superintendent of the Santa Cruz mines, situated near Durango.—The W. Bartning company of the city of Durango has acquired title to a group of mining claims in the Topia district.—C. Alinas is installing new equipment at the Discordia mine in the Guanacevi district preparatory to increasing the rate of output.

ONTARIO

Cobalt.—The Nipissing during February mined ore of a net value of \$124,391, and shipped bullion from its own and custom ores of an estimated net value of \$234,374. An action has been brought against the company by the Moore

Filter Co. of New York which claims \$600,000 damages for infringement of its patent rights in the 'Moore Filter' used in the filtration of slimes, and asks for an injunction preventing its further use by the Nipissing company.

The annual statement of the McKinley-Darragh for 1920 shows a net loss of \$40,574. The value of ore produced was \$414,815, and the cost of production including depreciation was \$432,283. The average cost of production was 85½c. per ounce. While it will be possible to reduce the operating cost owing to reduced wages and prices of material, the report concludes that it is improbable that the remaining ore, which averaged approximately 9 oz. of silver to the ton, can ever be produced profitably at around the present market prices. The re-opening of the mine is conditioned on a real strengthening in the world demand for silver bullion.

Larder Lake.—An application by Fasken & Co. on behalf of P. Kirkegaard for an injunction to restrain Goldfields, Ltd., from disposing of its assets to Canadian Associated Goldfields, Ltd., has been dismissed by the Court.

Porcupine.—The Hollinger Consolidated is planning to resume operations at full capacity on April 9, when it is expected that the difficulty due to power shortage will be at an end. A call has been sent out for miners, who are promised permanent positions, and the management hopes to secure a force of about 2000 men.—The Dome Mines and McIntyre are also making preparations to largely increase their output as soon as more power is available.—Results of operations at the Davidson Consolidated during 1920 proved disappointing. A total of 3003 tons of ore was treated with a recovery of only \$11,210, or an average of \$3.75 per ton, which was considerably exceeded by operating costs.

South Lorrain.—The Haileybury-Frontier property is being steadily worked for the recovery of the metallic cobalt and cobalt oxide contained in veins carrying low silver content.

SPAIN

Madrid.—A commerce report says that owing to labor difficulties and the increased price of combustibles, the metallurgical industry of Spain is experiencing an extremely dull period. A large zinc-plant and a plant producing electrolytic copper and brass in Asturias have been closed. In Dijon all of the plants remain closed on account of labor difficulties which developed nearly two months ago.

YUKON TERRITORY

Dawson.—Arrivals from Mayo state that several parties have stampeded from there on a long 'mush' with dog-teams over the snow to Fort Norman, for the purpose of staking oil-claims. They will travel up the Stewart river to Lansing, where they will outfit, thence by way of the Stewart and Gravel rivers to the Mackenzie river basin, following the old Indian trail. They expect to travel about 15 miles daily, breaking trail all the way.—The Yukon Gold company has 1600 tons of high-grade ore sacked and piled at Mayo Landing, ready for transportation when the season opens. The company expects to have fully 3000 tons at the Landing before navigation opens. The ore will average 200 oz. per ton in silver and 70% lead.

A valuable placer-mining claim situated on Crofton gulch, to which the Canadian Klondyke Co. asserted ownership, has been pronounced the property of Mrs. Boyle by the Court of Appeals of Canada. Twenty years ago a concession was granted to the territory in which the claim is situated. The original holder of the concession was Col. Boyle. The placer claim was kept in good standing until 1920 when it was permitted to lapse. It then was re-staked by Mrs. Boyle. The legal point at issue was whether it had reverted to the Crown or to the Klondyke company, which had acquired the Boyle concession. If to the Crown Mrs. Boyle's position is sound and officials must accept her application for record. The courts having so decided the astute lady is in possession.

PERSONAL

The Editor invites members of the profession to send particulars of their work and appointments. The information is interesting to our readers.

Norman C. Stines is in New York.

Dorsey Hager is now living at Los Angeles.

W. W. Mein was here this week; he is on his way back to New York.

S. D. McPhee, of Hobart, Tasmania, arrived in San Francisco on March 15.

Waldemar M. Ervin has moved from Moran, Kansas, to Socorro, New Mexico.

J. B. Tyrrell and William Frecheville have been on a visit to Calgary, in Alberta.

W. E. Sands is mill-superintendent for the Leadville Mines Co., at Gerlach, Nevada.

Michael Merrick has moved from Wickenburg, Arizona, to Hope, British Columbia.

H. Hardy Smith, who is now in New York, is expected shortly in San Francisco.

Blamey Stevens, formerly of Triunfo, Baja California, is now at Nogales, Arizona.

Seeley W. Mudd has been staying at the Claremont hotel, Berkeley, during the past week.

Herbert R. Hanley has returned to Bakersfield from a metallurgical inspection in British Columbia.

G. S. Dyer, general manager for the Orsk Goldfields, Ltd., is in San Francisco, on his way to Vladivostok.

D. D. Muir Jr., of the U. S. Smelting, Refining & Mining Co., Salt Lake City, was at Los Angeles during the last week.

Cecil Fitch, manager for the Chief Consolidated Mining Co., has returned to Eureka, Utah, after a holiday at Honolulu.

C. H. Doolittle, formerly well known as a metallurgist and now described as "a Ukiah sheep-man", is on a visit to San Francisco.

James F. Kemp, Professor of Geology in Columbia University, has been delivering a series of lectures at McGill University.

J. W. Mercer, general manager for the South American Mines Co., has returned to New York from the company's mines in Ecuador.

F. M. Stephens, manager for the York Mining Co., operating a uranium mine near Moab, Utah, has resigned and has moved to Denver.

Henry W. Gould and John Mocine have formed a partnership for general engineering practice in the fields of both mining and oil, with offices in the Kohl building, San Francisco.

M. Y. Williams, who has been on the staff of the Canadian Geological Survey since 1912, has assumed his duties as professor of paleontology in the University of British Columbia, at Vancouver.

J. A. Bancroft has been given a year's leave of absence from McGill University in order to become assistant general-manager to the Granby Consolidated Mining, Smelting & Power Co., at Anyox, B. C.

J. A. T. Robertson has resigned his position as metallurgist with the Missonri Cobalt Co., at Fredericktown, to accept an appointment with the Yunnan Ming Hsing Mining Co. at Gengyueh, in Yunnan, China.

T. B. Hine, until recently physical chemist at the Southwest Experiment Station of the Bureau of Mines at Tucson, is now chief of the physical chemistry department of the research and development division of the Chemical Warfare Service at Edgewood Arsenal, Edgewood, Maryland.

THE METAL MARKET



METAL PRICES

San Francisco, March 22

Alum. mid-st. cents per pound	75
Alum. v. cents per pound	7.50
Copper electrolytic cents per pound	13
Lead 160 cents per pound	4.25-5.25
Platinum pure per ounce	\$75
Platinum 10 iridium per ounce	\$105
Quicksilver per flask of 75 lb.	\$15
Spelter cents per pound	7.50
Zinc dust, cents per pound	12.50-15.00

EASTERN METAL MARKET

(By wire from New York)

March 21—Copper is inactive but easy. Lead is dull but steady. Zinc is stagnant but firm.

SILVER

Below are given official or ticker quotations for silver in the open market as distinguished from the fixed price obtainable for metal produced, smelted, and refined exclusively within the United States. Under the terms of the Pittman Act such silver will be purchased by the United States Mint at \$1 per ounce, subject to certain small charges which vary slightly but amount to approximately three-eighths of one cent. The equivalent of dollar silver (1000 fine) in British currency is 46.05 pence per ounce (925 fine), calculated at the normal rate of exchange.

Date	New York cents	London pence	Average week ending	Cents	Pence
Feb. 15	57.00	33.50	Feb. 7	01.00	30.13
" 16	55.75	32.50	" 14	01.70	30.32
" 17	55.50	32.25	" 21	05.81	34.04
" 18	56.25	32.02	" 28	05.67	32.22
" 19	57.75	33.50	Mar. 7	04.18	31.52
" 20 Sunday			" 14	05.12	32.01
" 21	57.87	33.02	" 21	05.09	33.00

Monthly averages	1919	1920	1921
Jan.	101.12	132.77	65.05
Feb.	101.12	131.27	59.55
Mar.	101.12	125.70	...
Apr.	101.12	119.66	...
May	107.23	102.69	...
June	110.50	90.84	...

Monthly averages	1919	1920	1921
Jan.	103.75	89.00	50.00
Feb.	100.00	81.00	48.75
Mar.	72.80	87.00	...
Apr.	73.12	100.00	...
May	84.80	87.00	...
June	94.40	85.00	...

COPPER

Prices of electrolytic, in cents per pound.

Date	1919	1920	1921	Average week ending	1919	1920	1921
Feb. 15	20.43	19.25	12.94	Feb. 7	20.82	10.00	...
" 16	17.34	19.05	12.84	" 14	22.51	19.00	...
" 17	15.05	18.49	...	" 21	22.10	18.75	...
" 18	15.23	19.23	...	" 28	21.66	16.53	...
" 19	15.91	19.05	...	Mar. 7	20.45	14.03	...
" 20 Sunday			...	" 14	18.55	13.18	...
" 21	17.53	19.00	...	" 21	...	...	...

Monthly averages	1919	1920	1921
Jan.	5.60	8.65	4.96
Feb.	5.13	8.88	4.54
Mar.	5.24	9.22	...
Apr.	5.05	8.78	...
May	5.04	8.55	...
June	5.32	8.43	...

LEAD

Lead is quoted in cents per pound, New York delivery.

Date	1919	1920	1921	Average week ending	1919	1920	1921
Feb. 15	5.60	8.65	4.96	Feb. 7	5.53	8.63	...
" 16	5.13	8.88	4.54	" 14	5.78	9.03	...
" 17	5.24	9.22	...	" 21	6.02	8.08	...
" 18	5.05	8.78	...	" 28	6.40	7.28	...
" 19	5.04	8.55	...	Mar. 7	6.76	6.37	...
" 20 Sunday			...	" 14	7.12	4.76	...
" 21	5.32	8.43	...	" 21	...	...	...

Monthly averages	1919	1920	1921
Jan.	5.60	8.65	4.96
Feb.	5.13	8.88	4.54
Mar.	5.24	9.22	...
Apr.	5.05	8.78	...
May	5.04	8.55	...
June	5.32	8.43	...

ZINC

Zinc is quoted as spelter, standard Western brands, New York delivery, in cents per pound.

Date	1919	1920	1921	Average week ending	1919	1920	1921
Feb. 15	5.60	8.65	4.96	Feb. 7	5.53	8.63	...
" 16	5.13	8.88	4.54	" 14	5.78	9.03	...
" 17	5.24	9.22	...	" 21	6.02	8.08	...
" 18	5.05	8.78	...	" 28	6.40	7.28	...
" 19	5.04	8.55	...	Mar. 7	6.76	6.37	...
" 20 Sunday			...	" 14	7.12	4.76	...
" 21	5.32	8.43	...	" 21	...	...	...

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.	7.34	9.50	5.80	July	7.78	8.18	...
Feb.	6.71	9.15	5.34	Aug.	7.81	8.31	...
Mar.	6.53	8.03	...	Sept.	7.57	7.84	...
Apr.	6.49	8.70	...	Oct.	7.82	7.50	...
May	6.43	8.07	...	Nov.	8.12	6.78	...
June	6.01	7.02	...	Dec.	8.00	6.03	...

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, according to quantity. Prices, in dollars per flask of 75 pounds.

Date	1919	1920	1921
Feb. 22	17.50	17.50	17.50
" 28	17.50	17.50	17.50

Monthly averages

	1919	1920	1921
Jan.	103.75	89.00	50.00
Feb.	100.00	81.00	48.75
Mar.	72.80	87.00	...
Apr.	73.12	100.00	...
May	84.80	87.00	...
June	94.40	85.00	...

THE PITTMAN ACT

In a letter to the 'New York Times', Sidney J. Jennings, president of the United States Smelting, Refining & Mining Co., points out clearly why any action toward the repeal of the Pittman Act would be not only unnecessary, but unjust. Mr. Jennings' letter is as follows:

"In a recent editorial article headed 'The Silver Crime of 1921', you advocate that the United States government should repeal the Pittman Act. The main argument you use is that the Government can, by purchasing silver at the present market price, make a profit.

"This profit would be in addition to the one it already made when it sold some of the silver in its Treasury under the Pittman Act at \$1.01½ per ounce, largely to the British government, in order to satisfy the silver needs of India. In 1917 India was exporting large quantities of material that was needed for war purposes. The only method of paying for this was to ship into India either gold or silver. Gold was unprocurable and, therefore, silver was shipped. A very rapid increase in the price of silver took place, until, in September 1917, sales were made as high as \$1.14½ per ounce.

"This rapid rise alarmed the British authorities. They realized that unless the needs of India were satisfied its demand for silver would bring about a crisis that the Allies could not then face, and the British authorities also knew that the only place in the world where a volume of silver existed above the ground sufficient to satisfy the demands both of India and China was the United States Treasury.

"Negotiations were started in order to release some of the large quantity of silver stored in that Treasury. The silver producers of the United States realized that if the Government kept its hands off the silver market their product would command as proportionately high a price as other products, such as wheat, cotton, and steel. They, therefore, formed associations and sent representatives to Washington to present their view of the situation. As a result of these discussions, Congress passed the Pittman Act in April 1918.

"Meanwhile the price of silver had gone down, but as a result of the passage of the Pittman Act the price was temporarily fixed at \$1.01½, and remained at that price for several months, until all the silver dollars called for were melted. According to the report for the year 1920 of the Director of the Mint 270,121,554 dollars were melted under the Pittman Act.

"This melting would, under the terms of the Act, require the re-purchase of about 208,000,000 oz. of silver produced in the United States from ores mined in the United States. Of this amount, some 37,000,000 oz. in round figures, have been re-purchased by the Treasury Department at a price of \$1 per fine ounce.

"In the original purchase of the silver which had been coined into the dollars that were melted under the Pittman Act, the United States government made a very large profit as seigniorage. When the entire re-purchase of 208,000,000 oz. is completed at \$1 per ounce, the United States government will, according to the Director of the Mint, neither gain nor lose, although there is, according to the same authority, a small profit of \$692,008 in manufacturing silver dollars into subsidiary coins under the terms of the Pittman Act.

"Thus the United States government, when the terms of the Pittman Act are carried out, will have in its Treasury exactly the same number of silver dollars that it had before the operation of the Act, and will have maintained and slightly added to the profit made through seigniorage, and will have kept faith.

"The Pittman Act was undoubtedly a solemn agreement between the Government of the United States, representing all the people of the United States, and the silver producers of the United States, which was faithfully adhered to by the silver producers and should now be faithfully adhered to by the Government of the United States."

MONEY AND EXCHANGE

Foreign quotations on March 22 are as follows:

Sterling, dollars:	Cable	3.91½
	Demand	3.92½
Francs, cents:	Cable	7.02
	Demand	7.05
Lire, cents:	Demand	3.98
Marks, cents		1.08

Silver purchased by the United States Treasury under the Pittman Act up to March 6 totaled 41,507,261 ounces.

Eastern Metal Market

New York, March 16.

Most of the markets are stagnant and devoid of features. Copper has declined to lower levels and there is no support apparent.

While tin is a little higher, this is without much significance.

Demand for lead which was strong a week ago has quieted down.

There is no improvement in the zinc market but prices are fairly steady.

IRON AND STEEL

Although it is doubtful if the rate of buying amounts to as much as 25% of the country's capacity in rolled steel, accumulated orders have resulted in the resumption of independent plants in the Middle West. In one or two cases activity follows a three months' shut-down and re-employment is commonly at a 20% reduction in wages. Purchases from the automobile trade have helped, but stocks in manufacturers' hands seem still to satisfy to a marked extent, especially in the East.

A sharp falling away of the activities of the Steel Corporation subsidiaries has brought the steel industry as a whole probably below a 35% basis of operation. The Carnegie Steel Co. has withdrawn the blast on eight furnaces in the week and expects to have three more idle shortly, and one more corporation furnace is idle in the Chicago district. The corporation's rate of steel making is about 45% of capacity.

The downward trend which has characterized the pig-iron market for many weeks continues. A sale of Southern iron at \$24, Birmingham, has been made in the Chicago district, but the usual quotation is \$25. Lower quotations on foundry and malleable have appeared in the Chicago district. The market in the East is weak.

Steel prices are still more a matter of quotation than the test of large orders. The most important test the market for plate has had is the purchase of 2600 tons by a Pennsylvania tank manufacturer, the price being 1.97½c., Pittsburgh.

COPPER

In the absence of any supporting demand the market is weak and prices are lower. Consumers show only a light interest. Electrolytic copper has sold at 11.87½c., New York, or refinery, or 12c., delivered, in small quantities from one or two sellers, but the large producers continue to quote higher levels. But these low prices have been done in the small business that has been transacted. Lake copper is inactive and weaker at 12.12½c., New York, for early delivery. For forward positions electrolytic is quoted up to 12.25c., delivered, for May-June delivery. Germany continues to buy a fair amount with other countries following along in smaller proportions. Last week's export figures show Germany to have taken over half the outgo for the month, the total having been 10,428 tons.

TIN

The market situation and prospects may be summed up as follows: The lack of interest on the part of consumers together with their apparently large stocks and reduced manufacturing operations make it probable that some time will elapse before the market for tin will be active or strong again. There has again been a fair amount of business among dealers, mostly in March-April and April-May shipment from the East. Consumers do not enter the market. On the New York Metal Exchange 25 tons of March shipment was sold at 25c. on March 8 and 25 tons on March 9 at 28.50c. The advance of the last few days in the London market has caused this market to quiet down and yesterday

and Monday little business was done even between dealers. The London market is £5 to £6 per ton above that of a week ago, with spot standard at £157, future standard at £160, and spot Straits at £165. On Monday spot Straits sold here at 29c., New York, but yesterday fell to 28c., which it was a week ago. The low price is 27.12½c. on March 9. Arrivals thus far this month have been 148 tons with 1135 tons reported afloat.

LEAD

The marked activity and strength of a week or so ago have given way to much quieter conditions. Prices, however, continue unchanged and steady to firm. There is almost no selling by independent producers who appear to have withdrawn from the market. Were they to make quotations they would probably be 4.25 to 4.35c., New York, but the leading interest is apparently taking such orders as are going at its regular quotations of 4c., New York and St. Louis.

ZINC

This market is actually lifeless and heavy, but prices continue fairly steady at 4.75c., St. Louis, and 5.25c., New York, for prime Western for early delivery. Quotations for forward positions are scarce. The buying that is being done continues to be for hand-to-mouth needs from consumers who are operating, if at all, on a much reduced scale. They show even very little interest in acquiring stocks. Foreign zinc ore re-shipment metal seems to have disappeared. Output is at a low ebb, but is probably still in excess of demand.

ANTIMONY

The market is inactive and without feature except that some look for a higher tariff on the metal. Quotations are largely nominal at 5.25c., New York, duty paid, for wholesale lots for early delivery.

ALUMINUM

The leading maker quotes virgin metal, 98 to 99% pure, in wholesale lots for early delivery at 28c. f.o.b. plant, while the same grade is obtainable from other sellers at 23 to 23.50c., New York.

ORES

Tungsten: The market is without feature or quotable changes, with Chinese and other ores valued nominally at \$2.75 per unit and higher. Scheelite is quoted at \$3 to \$3.25 per unit, Eastern seaboard.

Ferro-tungsten is also in light demand at 58c. per pound of contained tungsten in the guaranteed lump form.

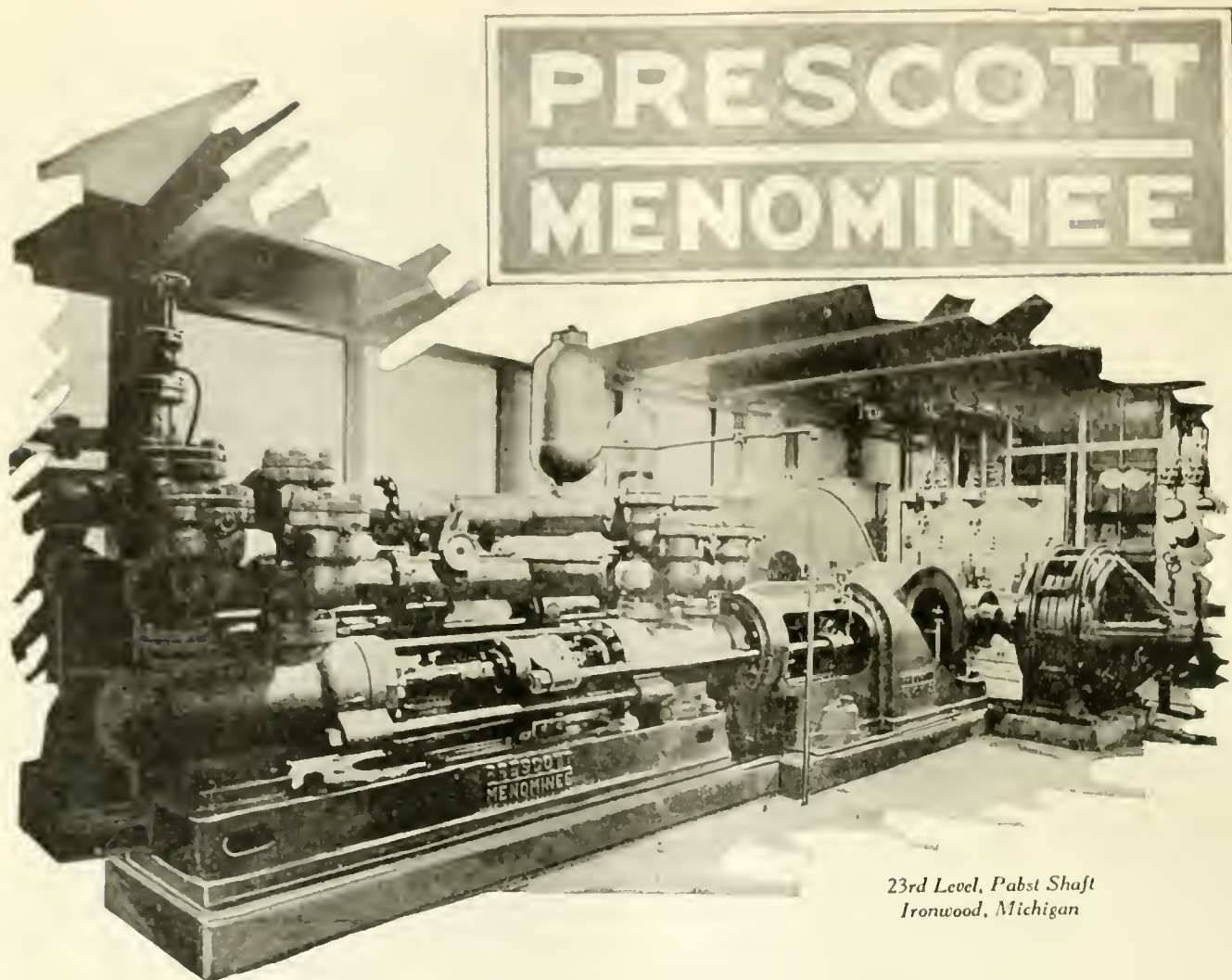
Molybdenum: Quotations are nominally unchanged at 55 to 60c. per pound of MoS₃ in regular concentrate. New York.

Manganese: There is no demand and quotations are nominal at 30 to 35c. per unit, seaboard, for high-grade foreign ore.

Manganese-Iron Alloys: The market for both ferro-manganese and spiegeleisen is stagnant with quotations unchanged. For American ferro-manganese the quotation is \$95 to \$100, delivered, and for the British it is \$100, seaboard, but it is believed any test of the market would lower prices. Spiegeleisen is quiet and except for a carload or two there is no demand at about \$35, furnace.

Ferro-silicon, 50%, is unchanged at \$92 to \$95 per ton, delivered, with the 10 to 15% electric product at \$45, furnace.

From January 1 to February 20, imports of gold amounted to \$65,967,915, of which \$30,994,000 came from Great Britain, \$11,878,000 from France, \$7,508,000 from China, \$2,208,000 from Japan, \$2,683,000 from Australia, and \$2,357,000 from Colombia.



23rd Level, Pabst Shaft
Ironwood, Michigan

Station Pumps in the Pabst Shaft

THERE'S no shambling or relaying of water with Prescott-Menominee Pumps and this installation in the Pabst Shaft of the Oliver Iron Mining Co., Ironwood, Michigan, is no exception.

Here each, for there are two, $4\frac{7}{8}$ " x 24" electrically driven Prescott-Menominee Pumps is delivering, direct to the surface, 400 gallons per minute and working against a 1700 foot head.

**400 Gallons
per Minute**

Head 1700 ft.

We specialize in Electric Pumps for deep mines and would welcome an opportunity to discuss your pumping problems with you.

THE PRESCOTT COMPANY

FRED. M. PRESCOTT, President
Menominee, Michigan



T. A. RICKARD, Editor

PRESIDENT HARDING'S inaugural ceremony cost a meagre \$1500, mostly for guard-rails and safety devices. The President is to be congratulated on the setting of an excellent example.

THE Government of the Federated Malay States purchased 10,000 tons of tin, produced locally, in an attempt to stabilize the market. It is stated that the amount incurred is to met with a loan, which will be issued at $6\frac{1}{2}\%$ at par.

SEVERAL tons of gold or seven tons of gold, whatever be the weight of Bolshevik bullion that is said to be awaiting shipment from Sweden, sounds big; but it does not represent an enormous sum of money, as money is counted in these days. Gold is worth \$602,875 per short ton.

THE secretary of the National Foreign Trade Council, Mr. O. K. Davis, is reported as having drawn attention to the fact that for fifty years or more the life of the nation has alternated from periods of hectic activity to those of hard times. A continuous foreign trade, in Mr. Davis' opinion, will act as a stabilizer; an adequate market in other countries will afford opportunity for steady employment at home.

ECONOMY usually follows simplification. According to the financial editor of the Philadelphia 'Public Ledger', there are about 20,000 different kinds of bank notes in circulation in the United States; for each separate design there must be an engraved plate, which is stored at the Treasury at Washington. Currency reform is urgently needed. The issuance of notes bearing the authorization of individual banks should cease, it is proposed; and Government notes of a uniform design should appear in their place. Obvious economies would be effected by the change.

WE have just received the March bulletin of the Institution of Mining and Metallurgy of London. It contains 42 pages of discussion and 17 pages of original contribution. This proportion is a normal one with our mining engineering friends across the Atlantic, and indicates a healthy interest in what is being published by their society. What is wrong with the papers issued by our own Institute, which usually fail to elicit any dis-

cussion? Are we afraid, too tired, or too busy, to criticize, to comment, or to give credit where credit is due?

RECOGNITION of the Mexican government under General Obregon is desired by those who wish to see friendly relations established between the two neighbor republics. The terms on which such recognition can be obtained were outlined by Senator Fall in a letter written on January 19; as he is now a member of President Harding's cabinet as Secretary of the Interior, it may be assumed that the conditions laid down are those that will prevail. These call for (1) the appointment of a commission to ascertain the damage done to Americans and American property in Mexico, as well as the damage done to Mexicans and Mexican property in the United States; (2) the appointment of another commission to settle boundary disputes; (3) the annulment of any law or decree depriving Americans of their rights to property legally acquired; (4) an agreement providing for the protection of American citizens and their property in Mexico in the future; and (5) the signing of a protocol embodying these agreements, with the declaration that the same shall be ratified in a treaty between the two countries so soon as the Mexican government shall be recognized. All this seems fair and reasonable. We hope it will be put into effect and that the friendly relations between the United States and Mexico may thereby be cemented.

ON another page we review Mr. J. H. Curle's latest book, 'This World of Ours'. It is a record of his travels all over the earth. Like Mr. E. T. McCarthy's 'Incidents in the Life of a Mining Engineer', a fascinating volume, particularly to the members of his own profession, this book by Mr. Curle contains no maps and gives no dates—an obvious defect, it seems to us, in a book of travel. Maps would add to, not detract from, the interest of the description. In the absence of dates, one cannot tell the period to which the author refers. In the two books, both by mining engineers, there is information that would be valuable if tied to time and place. The authors may reply that they do not expect to make their writings a source of scientific or economic information, and to that we can only demur by saying that an educated man who breaks into print ought to take his work seriously. Mr. Curle tells us about the excellent cauliflowers grown in the environs of

Jerusalem and mentions the fact that the Jerusalem artichoke is a corruption of the Italian *girasole*, the sun flower. To this we can add that we have had the same vegetable served to us as a 'Palestine' artichoke. Words suffer wonderful transmutations. Mr. Curle refers often to the coconuts and the cocoanut palm; he also mentions cocoa as a product of export from some of the countries he visited. The mis-spelling of such words makes them belie their meaning, for the coco nut and the cacao have nothing in common, even if the milk of the coco-nut is added sometimes to the chocolate-like beverage that is made by mixing the powdered seeds of the cacao with hot water.

A CHEAP method of transportation, to and from the railroad, may prove to be the decisive factor in the economic development of a small mining property. Narrow-gauge railways are unsatisfactory in that the track must be prepared to withstand severe service if a locomotive of adequate size and weight is used. The alternative is a light engine, light rails, and a small load. In this issue is described an interesting combination developed by the superintendent of motor transport to the South African Railway Administration, by which the advantages of the light rail and an almost unlimited number of cars are combined with the pulling power of a rubber-tired tractor on a prepared road-bed. The method is termed the loco-tractor system. The cars run wholly on rails. The front of the tractor rests on a bogey that acts as a guide and also runs on the rails. The driving-wheels of the tractor, with solid-rubber tires, run on prepared strips of road metal on each side of the railway track. The idea is novel and the advantages are obvious. The loco-tractor has been given a thorough trial, which has proved entirely satisfactory. There would appear to be much scope for the adoption of the system in isolated localities.

CURRENT Prices of Commodities is the caption of a new page that we introduce with this issue, and that we expect to publish each month with the prices carefully revised. Our object has been to make the list useful, and for this reason we have avoided the use of list-prices and discounts, stating instead the net price in terms of dollars and cents. We have also endeavored to make the specifications as clear as is practicable in the limited space available, and to use plain terms instead of the trade names and strange symbols that are entirely intelligible to our good friends who sell the things, but frequently bewilder such buyers as are not purchasing agents by profession. This feature should also appeal to our readers in foreign countries, who will doubtless be interested in the quotations given. It can be perceived readily that the list might be extended interminably; the difficulty is to select a few of the standard sizes and grades of the different commodities in order to afford the prospective purchaser a basis on which to estimate the prices of those not enumerated. Attention should be called to the fact that the figures are in no sense to be construed as quotations; they are given rather as a guide by which to follow the trend of the market or to estimate

the approximate cost of materials and supplies. In behalf of the firms who have been good enough to give us the information, we wish especially to warn the reader that he should not be hasty in concluding that he is being woefully mistreated if perchance some of the prices charged him are higher than those he finds given in our columns. Prices fluctuate; they vary according to the grade of goods, the quantity purchased, the kind of packing required, and sundry other things. We also bespeak consideration for ourselves on the part of the reader who may find our prices higher than those which he has to pay. We welcome suggestions as to additional commodities to be included in the list or other means of enhancing its value to our readers.

ONE of the serious drawbacks to the use of steel is its liability to oxidize and tarnish. The protection of the surface by the application and frequent renewal of paint is familiar, and indicates one of the methods in use to prevent rust. Any proposal that promises a reduction of such expense should receive consideration, so we publish in this issue an abstract from an article on a comparatively new material—a steel with about 12% of chromium—that resists corrosion to a remarkable degree. In England, where unplated steel cutlery is used to a much greater extent than here, the alloy was first used in the manufacture of table-knives, and was given the popular name of 'stainless steel'. The editor of the Journal of the Society of Chemical Industry retains this designation for the title of the original article from which we have taken our abstract, pointing out in a foot-note that 'unstainable' steel is meant. We go further and call it unstainable steel throughout the text, believing that it is an editor's duty, not only to correct, but also to insist that the correction, if logical, be adopted in general usage. It is unfortunate that the new chromium-steel should have been saddled with a popular designation that has done more than anything else to limit its application and restrict its scope in the minds of those interested in the corrosion of steel. To speak of the staining of steel suggests the familiar example of an ordinary knife after it has been used to cut a lemon; mention of the corrosion or oxidation of steel brings a vast number of other industrial, commercial, and technical operations within the range of notice. During the War, unstainable steel was used largely for the construction of aeroplane valves; and for this purpose it showed, in addition to its non-corroding feature, a satisfactory tensile strength at high temperatures. Its development in other branches of industry has been retarded because practically all the steel used during the war period was for war purposes only; a high-chromium steel, obviously, would have little application for castings of large size, where the surface is small in proportion to weight or volume. The possibilities in the adoption of the new alloy are considerable, and new uses will doubtless be developed as soon as its properties are recognized. It is easily hardened by exposure to the air, thus obviating the ill-effects arising from quenching with water. Tempering is performed as with ordinary steel, but at a higher temperature. When hardened it is

practically unoxidizable. Immersion in salt water or vinegar, or contact with the organic acids in common fruits, is without effect; samples that were buried in the soil for three months were found to have retained their original polish; the new steel is unaffected by strong or weak nitric acid or ammonia. After suitable treatment it has been found to possess mechanical properties comparable with high-grade nickel-chrome steel; and this fact will doubtless influence its adoption in many branches of engineering work.

Eilers v. Guggenheims

On April 6 the American Smelting & Refining Company will hold its annual meeting, on which occasion Mr. Karl Eilers, it is presumed, will make an effort to oust the Guggenheim brothers from the control. Whether he has obtained a sufficient number of proxies to effect his purpose we do not know; but sundry criticisms of the management will be made by him in justification of his recent campaign, the particulars of which we have recorded fully during the last three months. The 22nd annual report of the company is to hand, and we note that Mr. Simon Guggenheim, as president, congratulates the stockholders on a surplus of \$12,721 in 1920, as compared with a deficit of \$1,085,657 in 1919. He says: "This result has not been achieved without anxious thought and unceasing effort", in the face of declining business and industrial depression, particularly in the last quarter of the year under review. However, we note, with pleasure, his statement that the "labor supply is now ample both in Mexico and in this country, and is more efficient than heretofore". We presume that Mr. Eilers is of the opinion that the supply of directors is more than ample and that the management of the company's affairs would be rendered more efficient than heretofore if sundry gentlemen retired from the board. It is a matter of opinion. Mr. Guggenheim considers that "the bottom [of the metal market] has been practically reached, and that any substantial change in the future should be one of improvement". To that we say, Amen. Mr. Eilers, according to the 'Boston News Bureau', states that the Guggenheims are "willing to take on the board three representatives of stock interests and three nominees of other banking concerns with which they are particularly friendly". He asserts that the common dividend was not carried in 1920 and that the surplus is fictitious. "One of the means," he says, "by which the report avoids disclosing a deficit after the payment of dividends is to show a charge for depletion of only 41.7 cents per ton of ore mined, against a charge of 97 cents per ton in 1919. This expedient above made an apparent and fictitious saving of \$1,271,570." A report of the directors meeting of November 22, 1920, is included in the annual review of the company's affairs, in order to explain the reasons prompting the cancellation of the selling agreement with the Utah, Ray Consolidated, Chino, and Nevada Consolidated copper companies. The ball was set rolling by a suggestion from Mr. Charles Hayden, vice-president of the Ray Con-

solidated Copper Company, in which mention is made of "the continual conflict of interests" arising from the fact that the Smelting company was a buyer of copper from its customers as well as selling agent for the four 'porphyry' companies. The excerpt from the minutes shows how a profit was made on selling copper in good times and how a loss resulted on a declining market. We would suppose that shrewd men could have anticipated this; we have animadverted more than once in these columns on the practice of smelting companies acting as brokers and speculating in the copper of their customers. Why should not the customer be paid the price that the smelter gets for the copper in the ore sold to the latter? The copper is sold in advance and the price is known at the time of the settlement on the shipment of ore. It seems to us no more proper for the smelting companies to combine speculation in metals with the reduction of ores than for the anthracite mining companies to control the railroads used as common carriers by their competitors. The excerpt from the minutes would be more interesting if the figures covering the selling transactions had not been omitted. Why are the stockholders not entitled to have this information? Meanwhile we note a statement in the financial press announcing that the directors of the Smelting company have asked Mr. William H. Taft "to investigate charges made against the present management by a former vice-president and director of the company". Mr. Taft is an able and an honorable man. Perhaps Mr. Eilers will accept the suggestion, but perhaps he will not, basing his declination on the fact that Mr. Taft is known to be a friend of the Guggenheims. Cannot Mr. Simon Guggenheim and Mr. Eilers agree on a referee? That would seem the best way out of the impasse.

Silver and the Pittman Act

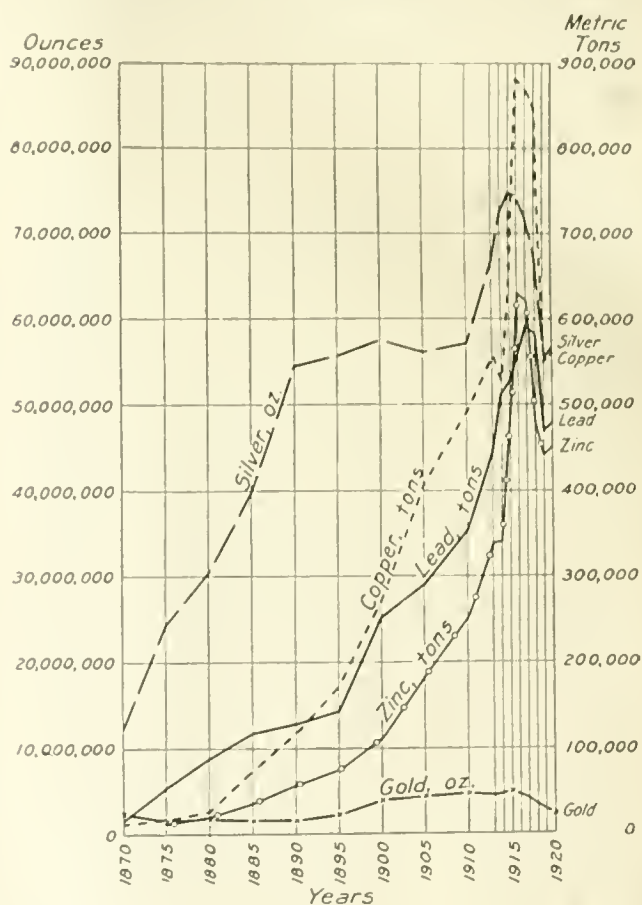
Attacks on the Pittman Act are appearing in the New York papers, and it is evident that an effort is being made to persuade Congress to repeal this legislation. Curiously enough Representative McFadden, the sponsor for the gold-bounty bill, is the legislator who has introduced a measure to effect the purpose. The 'New York Times', when announcing the resumption of the coinage of silver dollars at Philadelphia, for the first time since 1905, took the opportunity to print a headline stating that the Treasury was "paying \$1 an ounce for silver that sells in the market for 60 cents". This was being done under the Pittman Act, which was passed on April 23, 1918, at which time the Secretary of the Treasury, Mr. William G. McAdoo, in a letter to Senator Pittman of Nevada, the sponsor for the silver bill, recites the reasons prompting its enactment. He stated that more silver was required for the settlement of foreign balances, this method being adopted instead of attempting to stabilize exchange by methods that involved adjustment by means of shipments of gold, which was greatly needed at that time as a base for the huge structure of credit created by Government loans. Therefore 350,000,000 of the silver dollars stored in the Treasury were to be converted into bullion. A

dollar contains 0.7734 troy ounce of silver, and, having a fineness of 900, weighs 0.8593 ounce. The stock of such dollars was then 490,000,000, containing 375,000,000 ounces of fine silver, all represented by outstanding silver certificates. These were to be retired as and when the dollars were taken out of the Treasury, and in their place Federal Reserve bank-notes of various denominations were to be issued. Concurrently the Treasury was authorized to replace the silver thus used, for exchange and export, by the purchase of bullion on the market at \$1 per ounce and by coining this metal into standard dollars. The coining of the new silver was started only a few weeks ago, that is, nearly three years after the passage of the Act. It was anticipated at the time that the Government's purchases would absorb the entire output of silver from mines in the United States. Up to March 9 there had been purchased 41,507,261 ounces, whereas the output of silver from American mines was 67,810,139 ounces in 1918, 55,285,196 in 1919, and 56,555,650 ounces in 1920. On April 23, 1918, the price of silver in New York was 99½ cents per ounce; today it is worth on the open market only 57 cents. The melting of the dollars in the U. S. Treasury, under the terms of the Pittman Act, and the sale of the silver to Great Britain was an evidence of good-will, consummated at the crisis of a war in which Great Britain was our ally against Germany and her dupes. In a recent speech, made on the eve of his departure for India, as the new Viceroy, Lord Reading paid tribute to the friendliness of the United States in supplying England with the silver needed to relieve the critical condition of Indian exchange. In 1917 the demand for the products of the Orient had become pressing and a large adverse trade balance had been created. It was impracticable to ship commodities in exchange, as in normal times, and it was highly inadvisable to ship gold, because it would be hoarded and would disappear from use. In an editorial, the 'New York Times' says: "We blush to think that we sold \$300,000,000 of those cheap dollars at a handsome profit when silver was worth \$1.37 an ounce." Those blushes may now be spared, for the profit is going back to those who best deserve it, to those who produced the silver from the rock. Moreover, our great contemporary is in error; the silver was sold to the British Indian government at \$1.015 per ounce, not \$1.37; the total amount involved was 270,000,000 dollars, representing slightly less than 209,000,000 ounces of silver. For the silver shipped to China, the Treasury obtained \$1.29 per ounce, and a little extra profit besides. Up to the middle of March the Treasury had bought 41,000,000 ounces of silver, as stated already. A further 168,000,000 ounces will have to be bought in order to replace the 209,000,000 ounces, in the form of 270,000,000 dollars, taken from the Treasury. Naturally, if the purchasing of American silver under the Pittman Act ceases, the market for the metal will suffer, and quotations will recede further. It must be remembered that silver is not obtained entirely from so-called silver mines, it comes as a by-product from mines chiefly valuable for their output of gold, copper, lead, or zinc.

Fully 70% of the silver mined in the United States is a by-product in the winning of other metals. Therefore, any blow to the silver market affects the mining industry as a whole. The purchase of silver under the Pittman Act serves to stabilize the market; it is a good thing for the country as a whole; it would be unwise to repeal the Act at this time. We do not oppose the repeal in order merely to cater to a special class, for that we hold ever to be unwise, but to subserve a national interest.

The Future of Mining

In days like these, when a malaise seems to afflict mining enterprise and people talk as if they lacked the courage to face the abnormal conditions following in the wake of a cataclysmal war, it is worth while to take stock of the future. For that purpose we have reviewed the



past production of the principal metals in the United States and expressed their relationships by means of a graph, given herewith. This chart should be examined in connection with the statistics for the last half-century and for the last ten years. It will be noted at once that our base-metal mining industry, principally the production of copper, lead, and zinc, is of comparatively recent growth; prior to 1870 the output of these industrial metals was insignificant; during the life of men not yet old the development of mining has been stupendous, and it has been continuous. During 40 years, from 1870 to 1910, the production of copper, lead, and zinc progressed on a grand crescendo. This growth of production is

cheerful to contemplate, but it indicates a fact even more encouraging, namely, a continuous increase of consumption, chiefly domestic; in short, the development of in-

METAL PRODUCTION IN THE UNITED STATES, 1913 TO 1920

	Gold	Silver	Copper	Lead	Zinc
	—Ounces—		—Metric Tons—		
1913..	4,299,783	66,810,500	557,387	441,817	338,083
1914..	4,572,976	72,455,100	525,529	511,488	338,924
1915..	4,887,602	74,961,075	646,212	526,213	471,093
1916..	4,479,051	74,414,800	881,237	558,043	632,236
1917..	4,051,440	71,740,400	872,065	593,008	622,709
1918..	3,320,784	67,810,139	848,203	582,154	478,861
1919..	2,829,395	55,285,196	549,825	469,792	440,437
1920..	2,394,780	56,555,650	560,196	480,000	440,154

dustry on a continental scale in the United States has called for a continually increasing tonnage of metals, and the mines have yielded them for the benefit of all concerned. Next we turn to the last eight years, which we must consider separately, in order to appreciate the effects of the Great War. We include the year preceding

METAL PRODUCTION IN THE UNITED STATES, 1870 TO 1920

	Gold	Silver	Copper	Lead	Zinc
	—Ounces—		—Metric Tons—		
1870..	2,418,965	12,375,360	12,802	16,175	5,000
1875..	1,615,868	24,533,933	18,288	54,015	13,914
1880..	1,741,500	30,318,700	27,432	88,747	21,088
1885..	1,538,373	39,909,400	75,237	117,402	36,931
1890..	1,588,877	54,516,300	117,821	128,880	57,789
1895..	2,254,760	55,727,000	172,635	142,298	74,245
1900..	3,829,897	57,647,000	273,417	253,204	111,794
1905..	4,265,742	56,101,600	409,147	290,472	183,014
1910..	4,657,018	57,137,900	492,720	353,186	252,479
1915..	4,887,602	74,961,075	646,212	526,213	471,093
1920..	2,394,780	56,555,650	560,196	480,000	450,000

1914 because the accumulation of stocks of metal in Europe, especially by Germany, was a factor in accelerating the demand even before the declaration of hostilities. Production was checked in 1914, but the use of metals in the manufacture of munitions and in the making of the engines of war, including ships of all kinds, created an intensive demand here and in Europe, with the result that the production increased promptly until it reached a peak for copper and zinc in 1916, and for lead in 1917. The year 1916 marked the high tide of metal production in this country. This is nearly true of the precious metals also, as \$140,000,000 worth, of gold and silver, was produced in 1915. This constitutes a record. In 1918, the year of the Armistice, there was a decline, which continued and became more marked in 1919, especially as regards copper. The statistics for 1920 do not show a slump at the close of that year, but it is a fact that the production then had fallen to the rate prevailing before the War, except for zinc, which was still being produced at a rate higher than in 1913, partly because new uses had been found for that metal.

Turning to the chart, it will be noted what a sudden

and high peak was made by the demands of war. Before that event the increase of production was normal, that is, it was responsive to the demands of expanding industry all over the world, but particularly in our own country.

If now we project the normal curve, that is, the one recording production before 1910, we shall find that the output of copper in 1920 normally ought to have been about 630,000 tons; of lead, 450,000 tons; of zinc, 315,000 tons. If, however, we project the curve for the decade before 1910, that is, if we assume a continuation of the rate of increase prevailing before the War and the preparations for war, we find that the output in 1920 should have been about 710,000 tons of copper, 460,000 tons of lead, and 385,000 tons of zinc. Combining the two records, we are justified in concluding that if the War had not supervened the outputs of the three metals would have been about 670,000 tons of copper, 455,000 tons of lead, and 350,000 tons of zinc, as against 560,000 tons of copper, 480,000 tons of lead, and 450,000 tons of zinc actually produced in 1920. Of the three metals, zinc received the biggest stimulus during the War, owing to the enormous consumption of brass, but it must be mentioned, again, that many new industrial uses have been found for zinc, so that the estimate of an annual consumption of 100,000 tons above the old-time rate is reasonable. In that case, the production of lead and zinc in 1920 was about normal, whereas that of copper was about 100,000 tons below normal.

In studying such records it must be remembered that the curves of production and consumption are never coincident; they intersect, and then travel apart, because the factors that affect both do not influence them simultaneously. During the war period, for example, production was behind consumption at first; then consumption passed production; later the position was reversed again. The tides of commerce ebb and flow; movement is either forward or backward; complete equilibrium exists only for a moment. As the moon draws the waters of the sea, so the demands of industry pull upon production, and as the sun and moon together, by pulling in unison and in opposition respectively cause neap and spring tides, so domestic and foreign markets may coincide or may oppose each other in their action. Just now the perturbing effects of world-wide disorganization, political and industrial, are in full play; but they are of a temporary character and are bound to be succeeded by a restoration to conditions more nearly normal. Ebb follows flow; good and bad times alternate; periods of over-production follow those of excessive consumption; when the market is depressed it is sure to revive again; after a boom comes a collapse; the law of supply and demand is incorrigible. To the metal miner we commend one salient fact, namely, that the great increase of production during the fifty years preceding the War was commensurate with the increase of consumption. The output of one year may exceed the consumption in that year, leaving a surplus to depress prices, but over a half-century it can be assumed logically that the rate of production is the exact measure of the rate of consumption.

The War has not destroyed the demand for an ever increasing output of metals, it has only checked it temporarily, the call for metals is based upon the requirements of an expanding civilization. As the waste places of the earth are brought under cultivation, as distant mineral resources become exploited, as barbaric peoples learn to live under artificial conditions, as long as the world moves onward, there will be a constantly increasing use for the metals, and more particularly for those produced by our mines, because it is in the United States that they can be produced in greater quantity and more cheaply than elsewhere. The mining industry stands on a firm foundation.

Silver in Pre-Historic Times

To those interested in the researches of antiquaries we commend the study of a scholarly monograph on silver in Roman and earlier times, written by Mr. William Gowland, Professor Emeritus of Metallurgy in the Royal School of Mines, and communicated to the Society of Antiquaries, of London. The essay is of a type that we see but seldom in these days of commercialized effort; it is replete with facts and theories of historic interest. We learn that the discovery of silver arose, in all probability, as a result of the unpremeditated refining of lead-silver ore at the domestic hearth of the ancients. In fact, it is more than probable that lead and silver were discovered at the same time. In some cases the piece of galena, thrown carelessly into the fire, might have been melted into the soft malleable base metal; or the oxidation and volatilization might have continued long enough to drive off all the lead, leaving the silver. When fabricated into ornaments, silver had little chance of persistence under natural conditions. Sodium chloride is everywhere, even in the rain, especially in maritime regions. Silver chloride is easily formed, the reaction being accelerated by the nitrates and nitrites also present; so much so that it is surprising that any silver object buried in the ground in ancient times should have escaped complete solution. The amount of chloride available in certain districts is indeed surprising. In Italy, for example, investigations have shown that no less than 270 pounds of salt per acre was deposited for each inch of rain that fell. Roman denarii have been discovered as a result of archeological excavations that had, during the comparatively brief space of 17 centuries, been completely converted into shapeless masses of chloride.

Silver has not been found associated with the remains of men who were buried in the Paleolithic or Neolithic periods of culture. Gold has been encountered in the burial places of the Early Iron Age, but rarely silver. The first mention of silver as a metal, as far as can be ascertained at present, is contained in an inscription on a granite obelisk that was discovered at Susa, to which the date 4500 B.C. has been assigned. The inscriptions prove the use of silver as a monetary standard and afford evidence of the antiquity of civilization in the early Babylonian states. In Egypt there seems to have been a scarcity of silver in the earliest recorded times. During

the Eighteenth Dynasty (1650 to 1400 B.C.) silver was rarer than gold. An inscription on the *stèle* (a grave-stone) of Neb-oua, chief prophet of Osiris in the reign of Thothmes III affirms: "I have consecrated numerous gifts in the temple of my father Osiris; in silver, in gold, in lapis lazuli, in copper, and in all kinds of precious stones." A process of cementation was used in the 6th century B.C. and possibly in earlier times, for the separation of silver from the silver-gold alloy in which it is invariably found in nature. The description of one of the earliest of metallurgical processes, as reported by Diodorus, makes quaint reading: "The gold in the form of granules, together with various proportions of [lead?] salt, and barley bran, was placed in a porous earthen vessel and the cover was luted on with clay. The vessel was then placed in a furnace and heated continuously for five days and five nights. After this treatment the gold was left perfectly pure." The description, as Professor Gowland observes, is not more inaccurate than some accounts in our own times by non-technical men of processes of a similar character.

The monograph also contains a mass of interesting information with reference to the position of silver in the history of Crete, Greece, Phenicia, Cyprus, Etruria, the south-west of Asia Minor, Persia, Media, Pontus, and China. The subject is handled with the precision of the scientist. A perusal of the essay is exhilarating and at the same time restful—exhilarating because it indicates that unremunerative research is not dead; and restful, because it carries us beyond the realms of commercialism. We trust that Professor Gowland will continue his investigations, and we would invite him to consider a part of the world as rich in tradition as it once was in silver, namely, Peru and Bolivia. Prescott touches on the subject in his 'Conquest of Peru', telling the story of how the mines of Potosi were discovered by an Indian who pulled a bush out of the ground, to the fibres of which were attached a quantity of silver globules. This act marked the discovery of one of the greatest silver mines in the history of the world. Augustin de Zarate tells the story in his 'Conquista del Peru', of which an English translation was issued in London in 1581. The Inca Garcilasso de la Vega, in his 'Commentarios Reales' also gives much interesting information. The white metal was so plentiful that it was sometimes cheaper than iron, and we read in Prescott that Francisco Pizarro on one occasion had all his horses shod with it. How much silver came from the mines of Cerro de Pasco one can only conjecture, but the sight of one open-cut from which about 30,000,000 tons of ore must have been carried out on the backs of the Indians, and the knowledge of the fact that the ancient workings extended over 400 feet below this, give rise to vivid imaginings as to the amount of precious white metal that must have been removed during and previous to the Spanish occupation. We hope that if Professor Gowland continues his researches into comparatively recent times he will take into consideration the important position that South America once held as the greatest source of silver.



1. Water-tanks
2. Ore-train storage
3. V. T. & S. depot
4. Water-tanks
5. General office
6. Marion shovel
7. Osgood shovel
8. No. 4 hoist
9. Machine-shop
10. Slag-level, 5428 ft.
11. 300-ft. level, 5196 ft.
12. Rooms
13. Elev. 5990 ft.
14. No. 3 hoist
15. Change-house
16. 160-ft. level, 5313 ft.

The white line shows the pit boundary.

STEAM-SHOVEL OPERATIONS AT THE UNITED VERDE MINE

1. Boiler-house
2. Machine-shop
3. Warehouse
4. 160-ft. level, 5313 ft.
5. 300-ft. level, 5196 ft.
6. Elev. 5990 ft.
7. No. 3 hoist
8. Change-house
9. Slag-level, 5428 ft.
10. Rooms
11. Coal-docks
12. U. V. & P. Ry.
13. No. 5 switch-back
14. No. 4 switch-back
15. No. 3 switch-back
16. Hotel
17. 'Y'
18. Barracks
19. Water-tanks

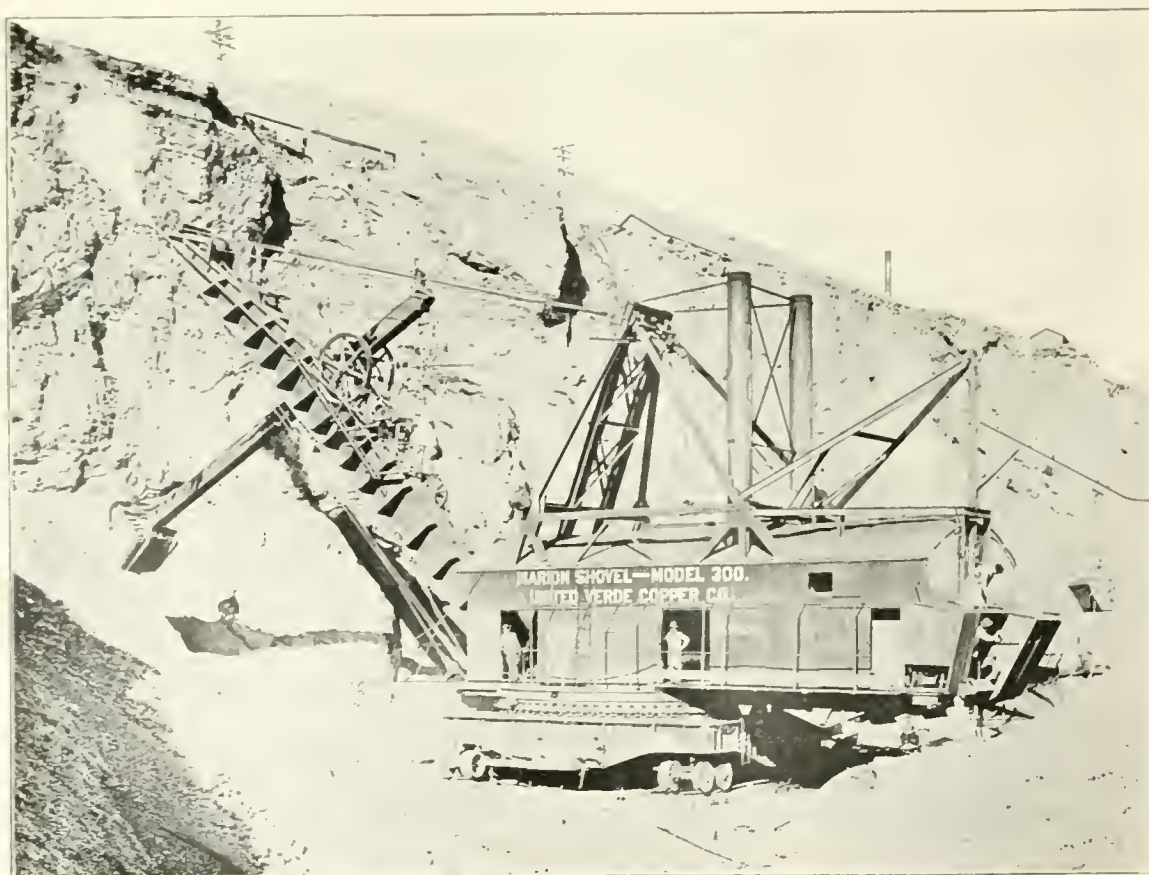


OUTLINE OF STEAM-SHOVEL PIT, SHOWING PARTS OF SURFACE PLANT THAT IS TO BE WRECKED



- 1 Slag dump
- 2 Boarding house
- 3 100 ft level
- 4 Barracks
- 5 Water tanks
- 6 No. 5 switch-back
- 7 Steam shovel shops
- 8 300 ft level
- 9 Narrow gauge railroad
- 10 W. I. V. Ex. mine
- 11 No. 4 switch-back
- 12 No. 3 switch-back
- 13 No. 2 switch-back
- 14 No. 1 switch-back

EXTENSION OF SWITCHBACKS NORTH-WEST OF THE STEAM-SHOVEL PIT, UNITED VERDE MINE



STEAM-SHOVEL IN USE AT THE UNITED VERDE MINE



ANCIENT METHODS



ON THE DOGALDINE RIVER



ON THE LENA



THE CLEAN-UP
SLUICE



A CHURCH AT THE MINES



A KEYSTONE DRILL



THE BODAIBO VALLEY



STARTING A PROSPECTING SHAFT

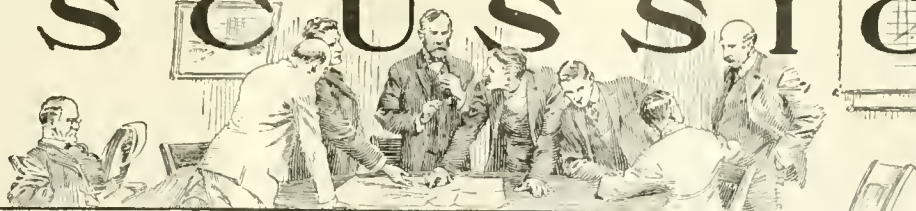


SLUICE-BOXES AND
RIFFLE



A HOME-MADE PUMP

DISCUSSION

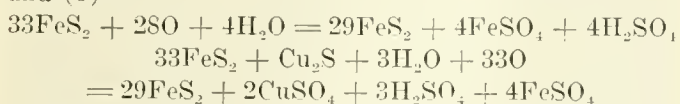


Metallurgical Methods at Rio Tinto

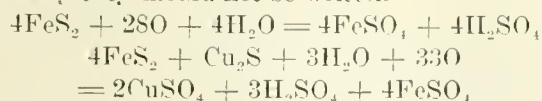
The Editor:

Sir—Mr. De Kalb's article in your issue of February 5 on this subject is an extremely interesting account of the present methods used there for extracting copper by heap-leaching. In view of recent interest in this country in the method, it seems rather too bad that the Rio Tinto metallurgists cannot furnish any better explanation of the reactions taking place in the heap than the ancient and honorable equations that have done duty for years in many other descriptions of the process.

Correcting the obvious clerical error in equation (5) which should read 33FeS_2 instead of 32FeS_2 , both (1) and (5)



seem unnecessarily cumbersome and there appears no reason why they should not be written



and it is not obvious why the particular excess of 29FeS_2 on both sides of the equation as written was selected.

While these same equations have been published for years, so far as I know, there has never been any evidence offered to substantiate the conclusion that they represent what takes place in the heaps. My own study of the process leads me to think that the following is a more probable explanation, although I have not had the opportunity to make the necessary investigations to prove it.

The direct oxidation of pyrite or of FeS is a reaction which begins slowly at comparatively low temperatures, and is of course much more rapid as the temperature rises. I do not recall any determinations made as to whether this direct oxidation reaction has a measurable velocity at ordinary temperatures, but in any case it seems probable that, similarly to many other reactions, moisture will act as a catalyst to measurably increase the velocity of the reaction at low temperatures. The reaction is strongly exothermic, and therefore the heat produced in the confined spaces of the heaps, with little chance for radiation, would tend still further to increase the velocity, producing additional heat, which would continue to increase.

This explanation would seem to be supported by the fact that the heaps heat-up, and that this heating-up must be carefully watched and controlled to prevent the heaps from igniting spontaneously. If this explanation

is correct, the minute amounts of SO_2 produced at any one time are no doubt oxidized to SO_3 in the presence of moisture and the relatively enormous surfaces which act as contact surfaces, and any correspondingly small amounts of iron oxides produced are dissolved by the acid produced in this way, with which they are in intimate contact.

The conversion of sulphides of copper to soluble sulphates can also be explained in the same way, and some forms of copper sulphide, as is well known, oxidize to form sulphates with much greater readiness than others; this is doubtless the reason for the special adaptability of the Rio Tinto ore to the method.

The above does not explain the removal of copper from the interior of a lump of pyrite, leaving the latter microscopically unchanged. This is no doubt caused by the penetration by reason of capillary action, of solutions, carrying salts of iron into the interior of the pieces, by direct solvent action of the sulphide by ferric iron, and by the reversal of the capillary action on drying the surfaces, bringing the solutions in the microscopic channels again to the surface carrying with them the dissolved copper.

Without more direct evidence, the above is speculative, and the matter is of sufficient importance to warrant the making of a careful and thorough investigation.

Los Angeles, March 12. G. D. VAN ARSDALE.

The Nitrate Supply

The Editor:

Sir—The editorial entitled 'The Domestic and Foreign Supply of Nitrate', in your issue of February 19, written, I presume, by Mr. Allen, was a comprehensive view of the subject. Why I mention this matter is because on the night of March 3 I listened to the debate on the Sundry Civil Bill in the House here. Included in the total of over \$384,000,000 was \$10,000,000 for the Muscle Shoals project, originally authorized by the National Defence Act, and approved June 3, 1916. The House Committee on conference could not agree to the Senate's amendment appropriating this sum. Mr. Good of Iowa, Republican, and chairman of the committee, led the debate. Mr. Almon of Alabama and Mr. Byrns of Tennessee, Democrats, protested against the appropriation being struck out. The former stated that nitrates could be made at Muscle Shoals at one-half the cost of the imported product from Chile. He also said that prices for nitrate were fixed in London, to the detriment of Amer-

lean farmers.* Mr. Mann, Republican, thought that his party had made a great mistake in the Muscle Shoals project, and at present he would vote against it so that the Sundry Civil Bill might pass; yet he would not cease in the future to endeavor to have the Government proceed with this great work. Mr. Good followed by saying that 190 Republicans had voted against Muscle Shoals, and desired to be shown that the expenditure of \$33,000,000 or more on the Wilson dam was justifiable. They also wished to be shown that the \$12,500,000 more, pending in another bill, was justifiable. He believed that the new administration would investigate and determine the project. The voting on the question that the House recede or concur in the Senate amendment was 144 for and 207 against. The Sundry Civil Bill passed the Senate, on recommendation of its conferees, minus the sum for the power scheme. Thus the Muscle Shoals scheme to produce synthetic nitrates is suspended for the time being.

M. W. VON BERNEWITZ.

Washington, D. C., March 4.

Chilean Nitrate and Synthetic Compounds

The Editor:

Sir—One point in the exceedingly able and interesting editorial, entitled 'The Domestic and Foreign Supply of Nitrates', which appeared in your issue of February 19, has left me, and I imagine a good many others, in somewhat of a quandary. Mr. Allen, for I take it the editorial is from his pen, states: "With regard to possible competition with synthetic products, it must be admitted that Chile will hold the field for cheap production of nitrates for some centuries to come."

It was, I believe, at a meeting of the British Association for the Advancement of Science, held at Bristol, in 1898, that the late William Crookes startled the scientific world by stating that if chemists did not soon devise some means by which the vast supply of nitrogen in the atmosphere could be brought to the service of man the world would be facing starvation within the coming half-century, for the beds of nitrate in Chile, from which the whole civilized world was drawing its supply, were approaching exhaustion. That Crookes had overdrawn the picture with a view to urging chemists to increased effort in this direction was, I believe, generally conceded by scientific men, but that he had some ground for his statement also was accepted. Since then nearly a quarter of a century has elapsed, and the world has been drawing on the supply in increased quantity year by year, until in 1913, the year before the War, the output of refined nitrate was more than two and a half million tons, an increase of more than a million tons compared with the year in which Crookes made his startling announcement.

What the output was during the War I have not seen, but, as nitrate is a prime necessity in the manufacture of nearly all modern explosives, I imagine it was in considerable excess of the pre-war figures. Either, then, Crookes must have erred greatly in his estimate or improved methods have made possible profitable extraction of nitrate from a far lower grade of caliche than was feasible when his estimate was made. I believe many besides myself would appreciate some more detailed information on this point. I have been laboring under the apparent error that the Chile nitrate beds were rapidly approaching exhaustion.

It has been a surprise to me that, since the commercial achievement of synthetic ammonia, no effort seems to have been made to fix the ammonia produced in phosphoric acid, and thus at once form an ideal fertilizer that needs only the addition of potash and possibly a little sulphur to make it contain all the inorganic ingredients necessary for plant life that are not found in the average agricultural soil. Though, of course, the farmer would have to be educated to apply such a fertilizer in small quantities, its manufacture should have an enormous sum each year in freight-rates that are being paid on inert material that is being transported as fertilizer. For more than 20 years, on and off, I have used a mixture of ammonium phosphate and potassium nitrate for house plants, giving them about as much as can be heaped on a ten-cent piece in about a quart of water once a week during the growing season, and, I can vouch from experience, the result has been magical. There seems to be no good reason why equally good results should not be obtained on a field-scale. I am inclined to think that for many soils such a fertilizer, which could be made at Muscle Shoals, would be better than Chile saltpetre, because with the latter nearly three pounds of soda has to be added to the soil with every pound of nitrogen, and in soils that already are heavily loaded with the soda salts this is a decided objection.

Another product that is manufactured at Muscle Shoals and that has proved its value as a fertilizer is calcium cyanamide. Owing to its caustic properties, I am aware that it cannot be sown on pasture or other growing crops, but where it can be drilled into the ground prior to seeding or to stimulate the growth of trees and shrubs I understand it has been very effective, and, as it gives up its nitrogen slowly, its effect is far more lasting than that of Chile saltpetre. Added to this there are few soils that are not benefited, and practically none that are injured, by the addition of the lime contained in the cyanamide.

I realize that a discussion on this subject at first blush would seem hardly to fall within the precincts of a mining paper, but, after all, it is necessary to feed the miner as well as everyone else, and, then, too, you still retain the word 'scientific' in your title, which would seem to give such a discussion an entrance. Bearing this in mind, I believe a discussion on this topic would be appreciated by many readers besides myself.

F. H. MASON.

Victoria, B. C., March 9.

*Nitrate price is fixed in Chile. American interest in the industry has been negligible; Great Britain has invested heavily. The high price results, not from British maliciousness, but because there is no competition from synthetic nitrate, the production of which, like the nitrogen itself, is still 'in the air'.—Editor.

Steam-Shovel Operations at the United Verde Mine

By Lewis A. Parsons

Since 1894 there have been scattered fires in the United Verde mine from the fifth level to the surface. Some of these fires were extinguished before they gained much headway, but others were persistent and smouldered for years in spite of everything that could be done, and the upper levels were so filled with gas that they could not be mined by ordinary methods. Most of these fires were caused by spontaneous combustion. Until 1908 the ore was mined by the overhand square-set system; and the large amount of timber, together with the fact that the ore was soft and friable, and high in sulphur, made such fires almost impossible to prevent, despite all the precautions that could be taken. Moreover, the ground was so broken and fractured that fires once started were controlled only with the greatest difficulty. Attempts to extinguish them outright always failed, although water, carbon di-oxide, and steam were each tried in succession, and with each fire it finally came down to bulkheading it as well as possible from the rest of the mine and letting it smoulder. Since 1908 the ore has been mined by cut-and-fill, shrinkage, and mill-hole systems, obviating dangerous amounts of timber previously used, and there have been no new fires.

The orebodies above the fifth level, however, contained large quantities of high-grade ore that could not be abandoned. These are locally known as 'fire-stopes'. The surface directly above the ore was covered with the old smelter and surface-plant, so that no settling could be permitted. Top-slicing was out of the question; open pits were impracticable unless it was desired to scrap the entire plant. The net result of these conflicting conditions was that the plenum system was adopted and used for a number of years with success. By this system air under a pressure of from two to five pounds is forced into the fire-stopes through carefully controlled passages, driving the gas before it and cooling the glowing sulphides until it is possible to mine them. Perfect control of the air is necessary; too low a pressure allows the gas to back up and interfere with the mining; too great a pressure increases the flames, just as in a blast-furnace. This control is obtained by a system of double doors that close all the workings between the fan and the fire district, and by a variable-speed motor on the fan.

That the system is successful is seen readily from its effect on the temperatures in the fire-stopes. When a bulkhead was first opened the sulphides were burning actively and all the exposed ground was aglow. The temperature was approximately 1200°F. In about six weeks the temperature was reduced to 120°, after which it subsided gradually to 100°. As the system was improved and altered to meet operating conditions, the ventilation was increased until at present the temperature has been reduced to 75°, an accomplishment that is a

tribute to the engineering skill brought to bear on the problem. This result was attained by controlling the exhaust-air from the stopes as well as the fresh air from the fan. At first the air from the stopes was allowed merely to escape through natural fractures to the surface, a method that resulted in uncertain pressure and allowed more or less of the hot gas to drift through the upper levels; later, raises were driven in the foot-wall to the surface, cross-cuts made to the stopes, and the escaping gas controlled by the doors.*

But the plenum system was expensive. There was a great deal of bulkheading, heavy timbering, and spiling, and the work was necessarily on a small scale. When mining in ordinary ground was costing from \$2.40 to \$2.75 per ton, mining in the burning ground cost \$6 per ton, a margin that could not be allowed any longer than necessary. The normal development of the property pointed to the remedy. First, a new smelter was built at Clarkdale, and a new surface-plant on the hillside at the 500-ft. level is just being completed. With the scrapping of the old surface-plant the last obstacle to open-cut mining disappeared, and the fire-stopes will be removed bodily by steam-shovel.

Briefly, the method will be to strip the overburden to the ore on the 300-ft. level, and then to mine down as an open-pit to the 400-ft. level, stripping enough of the hill above to make it safe. The general outline of the work is shown in the ideal section, Fig. 1, and the size of the undertaking and some of the natural difficulties to be overcome, in the photographs on page 447. The original estimate of the excavation required was 1,069,000 cu. yd. of ore plus 4,660,000 cu. yd. of waste. This was based on cutting only to the 300-ft. level, and on maintaining a $\frac{1}{2}$:1 slope on the hill above. A second estimate raised the quantity of waste to 5,960,000 cu. yd. by flattening the slope on the hill to $\frac{3}{4}$:1. Finally, it was decided not only to cut a level bench at the 300-ft. level, but to dig a pit down to the 400-ft. level, increasing the ore to 2,000,000 cu. yd.; and in place of a straight $\frac{3}{4}$:1 slope on the hill to substitute a series of benches of variable slope, as shown in Fig. 1, increasing the waste to 15,000,000 cubic yards.

The bench when completed will be 700 ft. high, and on account of the heavy rains this would not hold well on a

*The entire subject of fighting these mine-fires has been described in detail by Robert E. Tally, assistant general manager for the United Verde Copper Co., Trans. A. I. M. E., 1916. I am indebted to Mr. Tally for my information on the fire-fighting methods employed and for many courtesies extended to me while writing this article, as well as to E. E. Vanderhoef, superintendent of the steam-shovel department, to D. G. Evans, engineer, steam-shovel department, and to H. DeWitt Smith, superintendent of mines.

slope of 4-1. Another interesting argument for the slope as planned at present is that a man at the bottom close to the bench will be able to see only to the top of the first slope. Psychologically, this is important. It has been found that a bench with a uniform slope 700 ft. high worries men close to the bottom, as it looks as if they were not safe. Similarly, men working on any of the drainage ditches will not be able to see the rock more than one or two slopes above them.

The equipment will include two or three Osgood steam-shovels (Model No. 120) with 4-yd. dippers; one Marion (Model No. 28) with a $\frac{3}{4}$ -yd. dipper; one Marion (Model No. 300) with an 8-yd. dipper; one Browning 30-ton locomotive-crane; one Mann-McCann spreader; five or six standard (0-6-0) 82-ton switching-locomotives, made by the American Locomotive Co.; and two (0-2-0) light switchers for sharp curves. All tracks are of standard gauge with 75-lb. rails; switch-points and frogs are made of manganese-steel. Cars are of 20-yd. and 25-yd. capacity, made by the Western Wheeled Scraper Co., with automatic air-dump. It will require six miles of 3% grade to reach the upper stripping-level, which will be at an elevation of 5880 ft. The 300-ft. level, which will be the bottom bench, is at 5196 ft. From there the pit to the 400-ft. level will be 84 ft. deep. The 'Y' and ore-storage yards will be at the 300-ft. level.

The mining of the ore will be done principally with the big Marion shovel, illustrated on page 448. As this is the only shovel of this type (revolving) and size known to be used in copper mines at present, a few details are interesting. All other copper-mining is done with shovels of the railroad type. The standard dipper on the Model No. 300 Marion has a capacity of eight cubic yards. The steam is superheated. One of the most interesting parts of the equipment is the apparatus for loading coal, as shown clearly in the photograph. This was designed by Mr. Vanderhoef, and consists of an outrigger-derriek with a $\frac{3}{4}$ -yd. bucket. A car of coal is 'spotted' behind the shovel and loaded when needed. Two men can supply coal to the steam-shovel quickly and without hand labor, except to load the bucket. The shovel, as shown, is cutting the old slag-dump on the 160-ft. level, to get at the rock underneath, which in turn will be excavated until the ore is reached. The slag is mined without blasting. The bench is 115 ft. high and, as can be seen, is being taken in one cut. An ordinary railroad shovel would need to take two cuts for a bank this high, on account of the shorter boom.

Stripping will be done with the Model No. 120 Osgoods; road-building, cutting benches for the big shovels, and all odd work will be done with the Model No. 28 Marion with the $\frac{3}{4}$ -yd. dipper.

When the bench at the 300-ft. level has been completed, the pit will be started. The top of the pit will be 950 ft. long by 600 ft. wide; at the bottom (400-ft. level) it will be 760 ft. long by 400 ft. wide. This will be mined by the big Marion. This shovel, on account of its exceptionally long boom, can load into a car standing 45 ft. above, a reach that will enable the pit to be dug in two

benches. Another advantage of the long boom will be the distance the men can stay from the bench. The shovel will be cutting into old stopes, many of which are smouldering, and sulphurous fume would cause trouble if the men were too close.

The shovel will start down the pit on a 3% grade, loading into cars that follow on a track behind it. When down 40 ft. it will cut a slice the size of the pit, the tail of the track swinging behind it like a fan. When this cut is cleaned, the shovel will start down again until the bottom of the pit is reached, loading into cars on the 40-ft. bench. The tail of the track will be kept on this bench and shifted as the shovel enlarges its cut at the bottom, until the entire pit is excavated. Drainage will be effected by the stopes and raises that will be intersected. The surficial water will all be deflected; only the actual rainfall will go into the pit.

Much of the ore has been stoped already both by overhand stoping and square-setting before the fires started, and by the plenum system after. As a result, the steam-shovel will have pretty difficult picking at times as it works through and around these old stopes. Careful sorting will be necessary. There will be separate cars behind the shovel for ore and waste, and the shovel will dump into one or the other according to the material it picks up.

A recent estimate of comparative costs has shown that it will be cheaper to chop the ore through the four ore-raises that extend from the surface to the bins at the 1000-ft. level, and haul it through the Hopewell tunnel and thence to the smelter at Clarkdale, than it would be to haul it from Jerome to Clarkdale on the surface, as originally planned. The saving will be considerable, both in cost of new plant and in operating cost per ton, and there is no doubt that this is the method that will be adopted. When the mining has extended below the 300-ft. level and the pit is being excavated, as contrasted with mining the hill above, surface-haulage may be abandoned entirely, and the ore and waste milled through separate chutes from the bottom of the pit. This would permit the use of much steeper grades within the pit than if it were necessary to haul the ore and waste up-grade to the 300-ft. level. Indeed, it is possible that when this stage of the mining is reached the steam-shovels will be abandoned for ore-mining, and glory-hole methods be substituted, but such a change of method will depend upon comparative costs at that time and the relative cleanness of the products shipped to the smelter.

Drilling will be done by three kinds of drills, according to the type of work: bench-holes by Keystone well-drills, making a 5-in. hole 50 to 120 ft. deep; long holes in inaccessible places by Sullivan 3 $\frac{1}{4}$ -in. piston-drills; short holes by Ingersoll-Rand Jackhammers. The 5-in. holes will be sprung with 40% powder before loading the main charge. In ore, the benches will vary from 50 to 115 ft. in height. The burden on the holes will differ according to the type of rock, which changes abruptly. Diorite, schist, limestone, sandstone, and quartz-porphyry will all be encountered.

Figures on capacities of shovels and costs are dangerous before the work is well established, but Mr. Vanderhoef consented to the publication of the preliminary estimates. The model No. 300 Marion will excavate five yards per minute while operating, but due to delays that are unavoidable this shovel is rated at 1200 cu. yd. per 8-hour shift. The smaller Osgoods are estimated at 1000 cu. yd. per 8-hour shift. These shovels work faster, but they cannot reach as far or take as high a bench. Stripping will cost 70 cents per yard in place, including moving and dumping. This allows for car delays. Ore is estimated at 30c. per ton in cars for actual excavation, not including car delays. Both costs are total, and include overhead and repairs.

The entire work will take 10 to 15 years; its inception will end an era of restricted and difficult mining that has

Seward Peninsula, Alaska' (Bulletin 714-F). by George L. Harrington, issued by the U. S. Geological Survey.

Treatment of Taconite

At the recent meeting of the Canadian Institute of Mining and Metallurgy, reported in the 'Canadian Mining Journal', A. S. Dwight, whose connection with the Dwight-Lloyd process used at Babbitt gave especial interest to his remarks, said that the problems confronting Canada in developing her natural resources were ones that appealed strongly to confrères in the United States.

In the Mesabi range a new enterprise had grown up for the beneficiation of the taconite ores that form an important part of the deposits of the Lake region, and

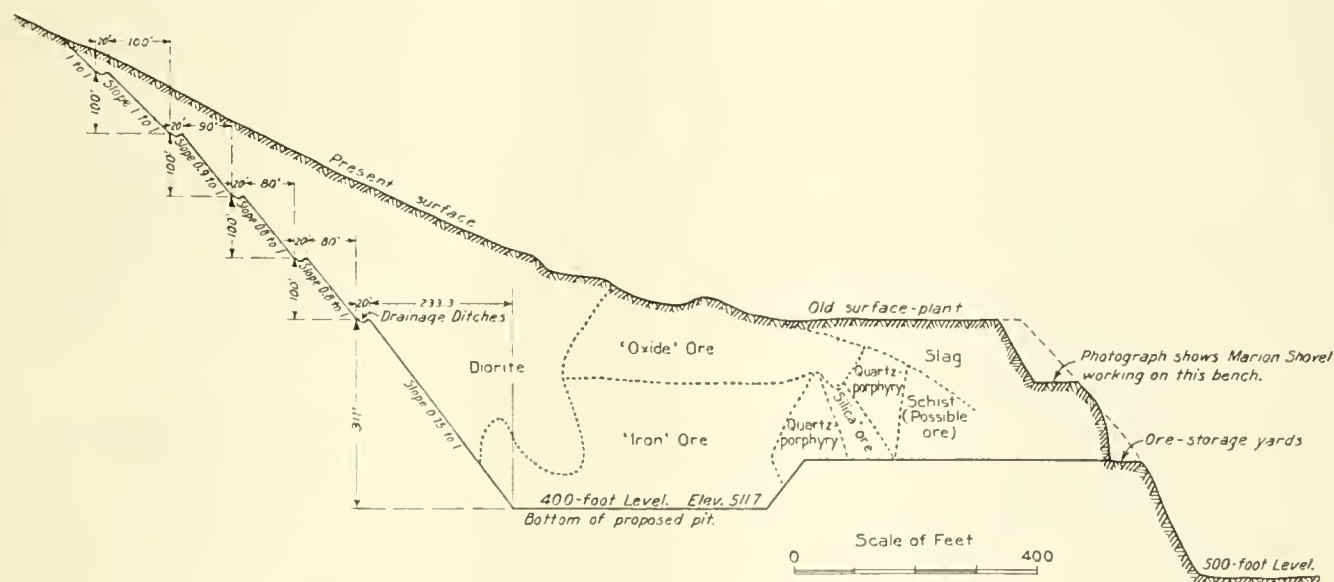


FIG. 1. SECTION OF GROUND SHOWING THE OPERATIONS PROPOSED

been expensive and unusually troublesome for the United Verde company. The entire ground around the old surface-plant is fissured and cracked, and through these small openings wisps of sulphur smoke are continually drifting, mute testimony to the condition of the ground beneath, and to the skill and persistence that have been necessary to mine such an area successfully by underground methods.

[The photographs illustrating this article will be found on pp. 447 and 448 of this issue.—EDITOR.]

THE FAMOUS Nome placer goldfields discovered in 1898 have now produced gold worth nearly \$80,000,000. Much of the gold mined in this region is won by the use of dredges. Twenty-two of these machines were in operation in 1919 and made a total gold output of \$450,000; open-cut and deep mining in that year brought the value of the total gold output of Nome and other districts of the Seward Peninsula up to \$1,360,000. In addition to the gold, about 56 tons of placer tin and 20 oz. of platinum was produced on Seward Peninsula in 1919. These operations are described in a report entitled 'Mining on

a problem presented itself that is now being attacked in a serious way. Profiting by the experience in the low-grade porphyry copper ores, the Mesabi company, financed by Hayden, Stone & Co., headed by Mr. Jackling, has undertaken to beneficiate these taconite deposits. The problem has been studied for several years and thousands of tests have been made. The first unit is now under construction and will demonstrate on a working scale the practical success of the enterprise.

The crude agate ore, containing 30 to 35% of iron, is blasted and gathered by steam-shovels, crushed to a fine powder, concentrated in log-washers—modified by some electrical device that has been worked out—dewatered, and passed over Oliver filters, after going through a Dorr classifier; is then mixed with the necessary amount of carbon before reaching the sintering furnaces. The reaction was likened to the process of the burning of a cigar, the combustion proceeding from the top downward and developing a temperature of from 1000 to 1200°C., inducing a condition of semi-fluid mobility. The resulting sinter is not unlike coke, and responds readily to the reducing action of the blast-furnace.

Antimony

*Antimony is a brittle white metal, having a specific gravity about 6.7. It melts at 630°C., and volatilizes at about 1500°C. The chief antimony mineral is stibnite or antimony glance (the sulphide), which occurs as compact or coarsely crystalline masses in lodes or veins nearly always associated with eruptive rocks. The chief oxidized minerals are the sesqui-oxides, senarmonite, and valentinite. Of the numerous complex sulphides containing antimony, the more important are jamesonite, pyrrargyrite, and tetrahedrite, which are frequently found in silver-lead ores.

Antimony lodes are usually simple in character, with no considerable extension either in depth or along the strike. The average width of the lodes at present worked does not exceed a foot, and few lodes are as much as a yard in width. Unless, therefore, the ore is associated with gold, silver, or some other mineral of economic value, it does not form a satisfactory basis for extensive mining operations. The minerals usually associated with antimony ore are arsenical pyrite, galena, copper pyrite, iron pyrite, and ores of gold, silver, and mercury. Gold is so frequently associated with antimony that the ore should always be assayed for it. Antimony ores occur occasionally in the form of bedded layers or lenticular masses, as for example the layers of oxidized ore mined at Djebel-Hamimat in Algeria.

When prepared for market, antimony ores should be as free as possible from such deleterious impurities as lead, copper, arsenic, zinc, and bismuth. The limits allowed are 0.1% each of arsenic and copper, and 0.2% of lead.

The ordinary metallic antimony of commerce is known as 'antimony regulus'. Ligated antimony sulphide, which is produced by heating the sulphide ore to a red heat sufficient to melt the material without decomposing it, is known in the trade as 'antimony matte', 'crude antimony', or 'needle antimony'. 'Star metal' or 'star antimony' is the highest grade of refined antimony, the best brands containing 99.6% of the metal. 'Antimonial lead' is obtained during the process of smelting certain lead ores containing antimony.

Pure antimony metal, in powdered form, is used to give a steel-like polish to articles made of pottery, and various articles of a decorative character are prepared from the metal. Antimony readily forms alloys with most of the heavy metals, and these alloys are widely used. Alloyed with tin and lead it finds extensive use in the manufacture of type metal, the antimony imparting to the melt the property of expanding on cooling, thus producing a sharp impression on the cast. The numerous anti-friction metals are alloys of antimony with varying quantities of tin and copper. Britannia metal, which is used in the manufacture of cheap tableware, is an alloy of tin, antimony, and copper, containing from 5 to 10% of antimony. There are many alloys of industrial utility manufactured from varying propor-

tions of antimony, lead, copper, zinc, and tin. During the War a large amount of antimony was consumed by every belligerent nation in the manufacture of shrapnel bullets, which are hardened by the addition of from 12 to 15% of antimony.

Manufactured antimony compounds are of considerable commercial importance. The tetroxide is used in the ceramic industry for the making of opaque white enamel. The tri-oxide, known as antimony white, is used as a pigment. Other pigments are antimony vermilion, a red tri-sulphate of antimony; antimony yellow, produced by the slow oxidation of the sulphide; and antimony blue, produced by mixtures of the above with other minerals. Antimony sulphide is used extensively in the process of vulcanizing rubber.

In the year 1913 the chief antimony-producing countries were China, France, Mexico, Italy, and Australia, China being the foremost. During the period under review (1913 to 1919) great improvements were made in the methods of mining and smelting of antimony ore in China. The industry was consolidated; and the output of crude, regulus, and refined antimony was greatly increased. So long as extensive mineralized areas remain, where high-grade antimony ores can be obtained from shallow and easily worked deposits, it is probable that cheap labor will enable China to retain the position already secured in the world's markets as the principal source of the metal.

France continued to produce all the antimony required for domestic consumption, and was able to continue exporting the metal with little reduction of pre-war tonnages. Mexican mining suffered severely by the civil war and subsequent disorders, and very little antimony was produced between 1914 and 1917. With the advent of more settled conditions in 1917, antimony production again equalled the output for the year 1913. Italy greatly increased her production of antimony ore, the output rising from 1793 tons in 1913 to the record total of 6404 tons in the year 1916. Within the British empire, Victoria and New South Wales showed large increases in the tonnage of antimony ore mined, and Canada and the Union of South Africa produced considerable quantities of ore and concentrate.

Stimulated by the high price ruling for antimony, a large number of deposits were worked in the United States; but, with the fall in the price of the metal, most of these undertakings were compelled to close down and little antimony ore was raised in America during 1918. There was no production in 1919. During the War, Bolivia exported considerable quantities of antimony ore, chiefly to England, but nearly the whole tonnage shipped was obtained from numerous small deposits worked by the Indians in a primitive and wasteful manner. So long as the market price of antimony remained around £90 per ton, it was worth the while of European traders to finance the Indians and buy, at a high price, the ore they produced; but as soon as the price fell the Indians abandoned antimony-mining and returned to their former occupations.

* Abstracted from a bulletin issued by the Imperial Mineral Resources Bureau, London.

Russian Placer Mining—III

By L. A. Perret

PROSPECTING. British and American engineers, in discussing the problem of prospecting Russian (Siberian) placers, seem to forget that (1) for moderate depths, small prospecting pits compete advantageously with drilling methods; and that (2) drill-holes may not furnish complete and accurate information. The first of these axioms is of special importance in view of the number of shallow deposits in Russia, as compared with deep placers buried under overburden. The latter are confined, almost exclusively, to the Lena region; a few are found in the Nerchinsk (Transbaikal) and South Yenisseisk districts.

Russian miners have developed prospecting methods that came into general use over 100 years before the drilling of placers was introduced, and that have attained a high standard of efficiency. They have been adapted to the requirements of each goldbearing region; and, in an ingenious manner, they take advantage of local conditions. The Russian hand-prospecting methods for shallow placers, not exceeding 35 to 40 ft. from surface to bedrock, cannot only compete, but in many instances beat, every kind of drilling method, in speed as well as in cheapness. Pit-sinking in perpetually frozen or thawed ground costs from 30 to 38 cents per foot, raising the ground and superintendence included. I draw attention to the remarkable performance of the Siberian miner in throwing excavated ground with a shovel from the bottom of a shaft 15 to 20 ft. deep and 5 ft. 3 in. by 6 ft. 5 in. square. Owing to the unusual skill of the men in this particular there is no need for windlasses or other hoisting appliances when sinking a prospecting pit. A crew of 20 men, under one foreman and one assistant, can sink, in four winter months, from 300 to 400 pits of an average depth of 20 ft., or a total of from 6000 to 8000 ft. in 2000 working days, giving an advance per hour of total time of from 4½ to 6 inches per man. R. E. Smith and H. G. Hann give the following figures on work in Siberia under the same conditions: two Empire drills with a crew of 14 men drilled 6696 ft. in 2709 working days, with an average advance per hour of 2.1 ft. per drill, that is, 3.6 in. per man. Consequently, the evidence is entirely in favor of the Russian method. As for the cost, there is no comparison, especially if superintendence is taken into account. Moreover, against drilling there is the cost of the equipment, and transport. However portable the Empire drill may be, there is a possibility of breakage, necessitating repairs and causing delay. A field-forge and blacksmith outfit is needed. With the Russian method the whole equipment consists of picks, shovels, short crow-bars, and rope-ends to descend and ascend the pits. The initial expenditure is small and practically no transport charges are incurred.

The Russian method has also the important advantage of being entirely free from breakdowns of any kind, which are unavoidable with all methods entailing the use of machinery. In the Ural and other Siberian goldfields, where the winter frosts are not rigorous, pit-sinking in thawed ground, including timbering, hoisting, and removal of water by one 4-in. hand pump, costs about 50 to 70 cents per foot, and sometimes as much as \$1.20 if the inflow is heavy and three or four hand-pumps are necessary. If prospecting is done in the vicinity of working mines or in an accessible region, a small ½-hp. oil-engine is used to operate the pumps, reducing the cost of sinking to 50 or 40c. per foot.

The figures quoted show that Russian methods are cheaper; and their adoption, being based on serious study, have their *raison d'être*. I cannot see the advantage of drilling. If it were faster and cheaper than the Russian method, there would be a plausible reason to advocate its introduction; but even then it would not be advisable to substitute it for pit-sinking under Russian conditions. Economy to the detriment of accuracy is not good policy, especially in prospecting. Accuracy depends on the ratio of the volume of the sample to the volume of the gravel. Admitting, for example, that the thickness of the gravel in a prospected area is 5 ft., the volumes of a 4-in. drill-sample would be 0.0985 by 5, or 0.4925 cu. ft. The volume of a pit-sample would be 5.5 by 6 by 5, or 105 cu. ft., and 5 by 6 by 5, or 150 cu. ft., respectively, for pits having a section of 3.5 by 6 and 5 by 6 sq. ft. It would be against common sense to prefer the former to the latter. A drill-hole does not give information about the nature of the bedrock, whereas a pit exposes it to close examination. These remarks apply with equal force to the Keystone drill. In either case the weight of the sample must be multiplied by a factor, which depends on the distribution of the gold in the deposit, and is found by checking drill-records with the results of actual exploitation. This factor varies not only between different placers, but even in the same individual deposit. On the Lenskoie mines, the factor for Keystone drilling is equal to 4 in the upper course of the Bodaibo valley, 2.5 in the middle portion, and 0.8 to 1 in the lower reaches. The use of the factor is only possible in connection with placers that have already been worked; in unexplored localities it cannot, obviously, be determined beforehand. Rich placers may give poor drilling records; or the reverse might be the case. Of course, such risk of error also exists with pit-prospecting, but the chances of faulty estimation are far less. As regards the number of tests for the determination of reserves, the Russian method is far more accurate than the American method. According to the latter an average of

one drill-hole per acre is considered sufficient; in many cases one drill-hole or pit is put down every five or more acres. Thus, prospecting is effected in Russia by sinking pits every 5 to 10 sajenes (35 to 70 ft.), in straight lines across the deposit and from 25 to 50 sajenes apart; which means from 3 to 6 pits per acre. The Russian mode of procedure is more accurate, as indicated by the comparative volume of the respective samples.

Owing to the proportion of big stones and boulders (about 40%) in Russian placers, the driving of Empire drill-casing is impeded, and the frequent use of bits or the repeated abandonment of miscarried drill-holes makes the operation slow and expensive. This is the opinion not only of the Russians but also of expert American operators in Siberia. In comparatively few districts where deep placers occur, Keystone drills are used extensively. The Lenskoie company possesses 29, of which 20 are in constant work. Drilling is the only method for prospecting alluvial deposits of great depth, but it must be borne in mind that the defects resulting from the unfavorable ratio of the volume of the sample as compared with the volume of the deposit are inherent to the method. Such drills can be used only in the vicinity of working mines, being entirely unfit for searching purposes. It is impossible to transport a Keystone over Siberian marshes or through dense forests obstructed by wind-fallen trees, difficult even for a pack-horse; or across fields covered with a layer of five feet of snow. The Lenskoie company tried a Keystone in an isolated region, with deplorable results, both economical and technical, the drill greatly embarrassing the movements of the prospecting party. Under Russian conditions, mobility is essential to success. There is, however, one judgment of foreign critics about Russian prospecting practice, the justness of which cannot be denied: that prospecting is never kept far enough ahead. Most foreign engineers ascribe this to ignorance and condemnable routine, whereas the true reason is want of capital—the chronic complaint of Russian mining undertakings.

DREDGING. The first dredge in Russia, made by Werf Conrad, of Haarlem, was erected by me on the Urusha river, a tributary of the Amur, in 1894. Many alterations have, since then, been made in an effort to adapt dredges to Russian conditions, but the open-connected New Zealand type has been retained in the great majority of cases. This type possesses features that, under conditions prevailing in Russia, should not be overlooked. As regards transportation, the case of the Lenskoie company and the 17-ft. bucket Bucyrus dredge will serve as a vivid illustration of the difficulties Russian placer mining has to contend with when heavy loads are in question. The company has the alternative of spending, for inland transport, a sum equal to the cost of the dredge, that is millions of rubles, or of organizing a quasi-arctic expedition to the mouth of the Lena river. The New Zealand type of dredge, few parts of which exceed in weight the load a horse can pull with a sleigh, is better fitted for remote and inaccessible districts than the close-connected American type, nearly every part of which requires a

team for transport. Teaming enhances the cost of transport enormously, as the winter roads in Siberia are passable for one-horse sleighs only; considerable expense being necessary in order to adapt them for team haulage, and to keep them open during snowstorms, not to speak of the cost of having special sleighs made. In the summer the roads to the goldfields are unavailable for loads exceeding half a ton, and in the majority of cases are passable for pack-horses only.

A great advantage of dredges of the New Zealand type is the possibility of repair on the spot, even in a provisional manner, of the vital part of a dredge, namely, the bucket-line. On most of the goldfields, especially in Siberia, breakage without ability to repair may mean stoppage for weeks, even the loss of a whole working season. The close-connected heavy type of dredge has been operated in California almost without breakage so long as it worked in easy ground, most of which had been handled before; but for work in stiff clay, bouldery, cemented, or partly-frozen virgin ground there is no dredge that, within the limits of a reasonable price, can be absolutely guaranteed against breakage. These two features, peculiar to the New Zealand type—facility of transport and easy repair—outweigh all the advantages of the Californian heavy dredge for work in Siberia. The Californian type may prove to be the best in individual cases, but the engineers who advocate its general use in Russia are mistaken. Mr. Purington is wrong in his assertions that "out of some 50 dredges that have been installed in Siberia, only about five are of any value as machines"; and that "one may say that the loss of these mechanical contrivances is not greatly to be deplored". The five Californian dredges have done no better work than the others, at any rate, not in proportion to their higher cost.

GENERAL EXPENSE AND ADMINISTRATION. As the physical features of a deposit influence the working cost, so in the same manner the general expense and cost of administration are dependent on the climatic and economic conditions of the country, its customs, and, last but not least, its legislation. The climatic conditions have not only a direct bearing on the working methods and costs, but affect the general expense connected with the enterprise. All Russian placer mines are situated in regions where the working season is short—from 100 to 120 days only—followed by a long and rigorous winter. Heavy expenditure is involved for heating, water-supply, and shoveling snow. The short time available for actual operation necessitates the maintenance of the entire staff during the idle season, or the engaging of a new staff each year. The majority of important undertakings prefer the former alternative, with a view to retaining the services of well-trained men. This involves heavy expenditure, as the idle period is twice the duration of the working season. This is the reason why foreign engineers coming to Russia to investigate mines seldom are able to secure the services of good foremen for temporary jobs. On account of this they complain of the low standard of the Russian with whom they come in contact.

The goldfields, being situated in extreme latitudes beyond the agricultural zone, have no settled population. All food-stuffs must be transported thousands of miles. The mine-owners are compelled to sell the necessities of life at prices fixed by the Government Inspector of the district, not only to their own men but also to the aboriginal Tungoose and Yakut tribes and the Russians supplying the mines with fuel and timber. Laborers, both skilled and unskilled, are recruited in regions remote from the mines, to which they are brought at the owners' expense. They also have to be sent to their homes at the expiration of their contracts. In recent years the workmen, at their own cost, come to some of the goldfields to be engaged; but this does not make labor recruiting any cheaper. If the influx is too great, the mine-owners have to send the surplus back to the nearest town, so as to avoid the congestion of an idle crowd without means of subsistence. Moreover, when the laborers come to the mines there is little opportunity of selecting good and experienced men. The problem of recruiting and victualling complicates the management of placer mines in Siberia and necessitates a special organization and the extension of the domestic department.

Another expense results from the Government regulations, according to which the mine-owners of each district are compelled to deposit jointly with the Treasury at the beginning of the year an amount equal to the annual salaries of the Justice of the Peace and the officers of the police force of the district. Moreover, they have to pay the traveling expenses of these men when a journey is made on official matters, and are bound to provide both offices and lodgings (heating and lighting included) for them, as well as for the employees of the post and telegraph office, if there be such at the mine. The cost of construction and maintenance of roads within the limits of the goldfield, as well as of the postal service between the nearest town and the mine, are borne by the owners. All these expenditures are assessed in proportion to annual output, and, in the end, involve a big addition to the general administrative costs of Russian placer mining, of which similar enterprise in America and other countries is free. The Russian mine-owners and managers are not in sympathy with the taxation, and have repeatedly protested; but so long as the present order prevails, all undertakings, domestic as well as foreign, must submit.

The Russian mining law is strict as regards the safety and welfare of the workman. The law prescribes, for instance, a minimum height of drifts and tunnels, two openings to the surface in all drift mines in which more than 25 men are working, special shafts for lowering timber, a minimum height of face (7 ft.) in open-cuts, and a minimum width of the terrace (10½ ft.), if the thickness of the overburden is such that it must be stripped by means of several benches. Elaborate regulations provide for the compulsory use of safety appliances on mechanical haulage-ways and gravity-tracks, transmissions, gearing, and machinery in general. Nearly all the accidents in placer mines are due, therefore, to the

carelessness of the Russian workman. These regulations affect the working cost, inasmuch as they restrict the performance of the work to rules that are not always consistent with economy. In America, a far greater margin for individual judgment is allowed, which permits the possibility of using the cheapest methods at the expense of safety. This probably accounts for the fact that America shows the highest percentage of avoidable accidents as compared with any other country.

Much of the questions relating to the employment of women and minors, discussed at the latest International Labor Conference, were solved long ago in Russia. The Russian Compensation Law, enacted on June 2, 1903, provides for liberal indemnities for the injured and large pensions for widows or orphans, and even for parents if the latter were supported by the injured. The compensation law acts automatically under the supervision of the District Mining Inspector, and without the need of action on the part of the injured, or the heirs of the deceased. Such legislation appreciably increases the cost of mining operations. Welfare regulations compel the employer to provide sanitary dwellings free of charge, with a minimum quantity of one cubic sagene of air per lodger, free medicine, and medical attendance, as well as to maintain hospitals with a capacity of one bed per 100 workmen. Every mine with 200 or more men is compelled to have its own hospital, with fully qualified doctors and staff. Companies employing less than 200 men may maintain a hospital jointly, provided the distance to the remotest mine does not exceed 25 versts (18 miles). It is the custom to give free medical service to the families of the men. The medical department is on an entirely satisfactory footing on all placer mines of large or moderate size. The Lenskoie company, for instance, has four large hospitals, each with from 50 to 80 beds; and a personnel of eight doctors, a complete staff of surgeons, pharmacutists, midwives, and trained nurses. There are four hospitals on the remote mines. The company also contributes its share of the expenses of the general hospital in the town of Bodaibo, maintained by the gold-producers of the Lena district. All the important mining companies have erected churches, sometimes even mosques for the Mohammedans, schools, orphan asylums, clubs and tea-houses, and provide for their maintenance. Amusements also are organized. Such provision, although essential on humanitarian grounds, involves enormous expense. Most American observers, in comparing costs with those of American undertakings, omit to take into account the peculiar conditions under which Russian mines are worked, conditions that are due to climatic and economic features, legislation, custom and usage, to which foreign enterprise in Russia will have to conform. American observers disregard the expenses caused by safety, sanitary, and welfare measures, which in Russia are compulsory, whereas in America they are optional. A comparison of costs is only of persuasive value if the conditions are the same, and the records are kept in the same manner. Unless this is observed, one may say that "*comparaison n'est pas raison*".

CONCLUSIONS Russian placer-mining methods have been criticized by almost every foreign engineer who has visited the country. Criticism is one of the elements of progress, and therefore helpful; but only if based on a thorough knowledge of the economic and financial conditions on which the industrial life of the country is dependent. Technical experience alone is not sufficient. *La critique est aisée, mais l'art est difficile*, is the saying. Criticism from a bird's eye view is of no avail; and this is the kind of criticism that most foreign engineers, especially American, have proffered with regard to Russian placer mining, forgetting that, until recently, conditions were similar on many goldfields in America. In 'Mineral Resources of the United States' for 1903 one may read that "in the Yukon region . . . most of the camps are so isolated as to make the cost of mining a very large percentage of [the value of] the production. In only a few instances have extensive mining plants been installed in this field, and most of the gold is taken out in small quantities by more or less primitive methods".

A certain correlation should exist between local conditions and efficient methods. If this correlation is disregarded the results will be fatal. Primitive methods may transgress, just as much as highly specialized ones; for the adoption of the latter may result in the introduction of appliances that are unsuitable. Improvements must keep pace with the development of the country. If the introduction of efficient mining methods has been more rapid in America than in Siberia, it is due to the faster development of Alaska, as compared with the Siberian backwoods. Methods used in Siberia have their *raisons d'être*, and these reasons are far more complex than may appear to those who make their observations from the windows of the Trans-Siberian express.

Owing to the isolation of nearly all the Russian placers, the delivery of machinery takes at least two years and a half from the date of the order. Suppose that the results of a season induce a company to introduce improvements and to order machinery at the end of the season, say, for example in October 1920. The manufacturer will want at least six months for delivery, this being the usual term under pre-war conditions. The shipping will require about two months. Thus the machinery will not reach a Russian port before May 1921. During the summer it will be transported to the station or port nearest to the mine. The machinery must be stored there until the opening of the winter road, when it can be transported to the mine, reaching there in the early spring, say, March or April, of 1922. The season will be spent in erection. Thus the improvement can be put into practice in 1923. If the original order is sent in January or February 1921, instead of October 1920, it would require an additional year. Few mine-owners in Russia have sufficient capital to be able to afford to tie it up for so long a period; few large companies are financially strong enough. The majority of shareholders are reluctant to sacrifice sure and certain dividends obtained by the old methods, which have stood the test of time, for profits that to the non-technical person appear

problematical. Placer mining in Russia has developed along broader lines than in Alaska and other American goldfields (dredging and hydraulicking excepted), where the average output of an individual mine does not exceed 250 cu. yd. per 10 hours. A Russian mine with an output of 700 to 800 cu. yd. per 10 hours is considered a small one. The equipment therefore requires a far smaller capital outlay than would be the case if an Alaskan derrick or self-dumping plant and scrapers were installed, which have proved satisfactory for small operations only.

No Russian engineer, and hardly a single mine manager, is unconscious of the defects of the methods he uses; but in all branches of industry, especially in mining, improvements are as much a matter of finance as of technical knowledge and skill. Progress in mining is not furthered by technicians alone; it is indicated by the general progress of the community. The confidence of the investors, partners, or shareholders in the success of technical improvements is indispensable to their introduction. The Russian public does not appreciate the requirements of the industry or the conditions necessary for success. In most instances where defective methods are being used, the lack of capital and the attitude of the Russian community are to be held responsible, not the technical staff.

Foreign engineers visit Russia for the evaluation of placer propositions. The main object being the collection of data for reports, they pay only slight attention to conditions that have given rise to the adoption of particular methods, and therefore criticize the defective application of the idea, instead of studying the idea itself with a view to improving its application. Many Russian methods would be successful if properly applied on American placer mines. Foreign placer mining in Russia has always been on foreign lines, economically as well as technically, and with an utter disdain of Russian methods. This has resulted in the loss of large sums of money. Mines where Russian methods are in use have yielded large profits. This contrast should induce reflection.

New mining ventures in Russia are viewed sceptically by investors; but America will, sooner or later, seek an opening for investment in the Siberian goldfields. Neither American capital nor Russian mining will profit by failure. To avoid waste of money, Russian experience should be combined with American energy and business insight.

[Illustrations referring to this article will be found on pp. 449 and 450.—EDITOR.]

THE COPPER MINES of the Chitina valley are the largest and richest thus far developed in Alaska. Their successful development has been made possible by the completion of the Copper River & Northwestern railroad, which affords transportation to tidewater. The recent mining progress in this district is shown in a report entitled 'Mining in the Chitina Valley, Alaska,' by F. H. Moffit, issued by the U. S. Geological Survey, Department of the Interior.

Tractors, Trailers, and the Loco-Tractor System

*Experiments have been made by the South African Railway Administration with petrol-paraffin tractors fitted with solid-rubber tires. The underlying principle of the type of tractor adopted was that it utilized the usual components of the motor lorry; but, by re-grouping the various parts of the machine, it is used for hauling the load on trailers. The results obtained in actual practice show that the rubber-tired tractor has the following advantages over the motor lorry:

1. The motor lorry has to stand idle while being loaded or unloaded; the tractor is constantly on the move, and does not require to wait while trailers are being filled or emptied. The result is that the tractor hauls three times as much as the motor lorry.

2. Owing to the saving of time during loading and unloading, the tractor's working costs amount to less than one-half those incurred in the case of the motor lorry.

3. The tractor-and-trailer system is adapted for the conveyance of any class of material. The use of trailers facilitates equal distribution of light and heavy articles, and permits the sorting of goods for different destinations.

4. The tractor need not wait for the trailer. This facilitates the obtaining of return loads.

The following, compiled from actual records and tests made by the Railway Administration, shows the working results:

	Petrol-paraffin solid rubber-tired tractor	3½ ton petrol lorry	3½-ton electric lorry	2-animal wagon	14 ton steam-traction wagon
Load per trip...	7 tons	3½ tons	3½ tons	2¼ tons	17½ tons
Trips per day...	16	10	10	9	4
Tons per day...	112	33	33	21	70

F. Dutton, superintendent of motor transport, South African Railways Administration, has designed a new form of locomotive which, if successful, may revolutionize the whole question of pioneer transport. Mr. Dutton's system is described as the loco-tractor system, and is based on the following fundamental principles:

1. The low tractive resistance of vehicles running on rails as compared with the high tractive resistance of vehicles running on roads.

Tractive resistance per ton:

Vehicles on rails	6.2 lb.
Vehicles on roads	56.2 lb.

2. The high tractive effort obtained by using solid rubber-tired driving wheels running on roads, as compared with the low tractive effort of locomotives running on rails.

Tractive effort per ton of axle load:

Solid rubber tires on roads	1330 lb.
Locomotives on rails	344 lb.

In order to take advantage of these factors, the loco-

tractor system uses trucks running wholly upon rails, thus securing the greatest possible efficiency in utilizing power for hauling purposes. The guiding portion of the loco-tractor also runs on the rails, but the driving wheels, shod with solid rubber tires, run on prepared strips of road metal on each side of the railway track; thus for a given horse-power and weight the hauling power is four times as great as with ordinary locomotives.

The outstanding advantages of the loco-tractor system are:

(a) As only the trucks and guiding portion of the tractor are carried by the rails, these do not require to be heavier than 16 lb. per yard. The weight on the driving wheels of the tractor does not affect the weight of the rails, as the driving portion of the tractor runs on the road wheelways and not on the rails.

(b) The high tractive effort obtained by the adhesion of solid rubber tires to a road surface enables the loco-tractor to haul a load up a steep gradient without difficulty. As a matter of fact the train can be started on a steep gradient without jerk or strain.

(c) As there are no coupled wheels on the loco-tractor and as the driving-wheels are fitted with a differential, 50-ft. radius curves can be negotiated without difficulty.

(d) The facility with which the loco-tractor takes curves and steep gradients simplifies construction in difficult country. At present the location of a railway is governed by curves and grades rather than by the best route for development purposes; not only are construction costs increased by the adoption of circuitous routes to avoid heavy gradients, but the line often has to leave the areas which produce the traffic, involving increased expense in carting to and from the railway.

(e) Light steel sleepers weighing about 6 lb., with hook-bolt fastenings, are satisfactory for the loco-tractor system. Stone ballasting is unnecessary, experience having shown that sand and gravel are preferable to stone ballast for the purpose.

When the idea of the loco-tractor system was submitted it was agreed to give it a trial; and the construction of a temporary track at Canada Junction, near Johannesburg, was authorized. Instructions were given that the test should be as severe as possible. Grades and curves were accordingly incorporated which were abnormal. The rails and sleepers were not ballasted, but merely laid down on the ground. The wheelways received no preparation beyond what resulted from the pressure of the wheels of the loco-tractor running over the track a few times. Special difficulties were introduced by placing the super-elevation on the wrong side of curves, by using crippled second-hand track, and by omitting check-rails from curves.

The curves were of various radii, the sharpest being of 37-ft. radius, and a balloon curve of 50-ft. radius formed

*Abstracted from an article in the 'South African Journal of Industries' by Sir William Hoy, general manager, South African Railways and Harbors.

part of the line. Fairly long gradients of 1 in 17 and 1 in 18 were used on the straight, and a gradient of 1 in 18 on a 100 ft. curve (equal to 1 in 14 on the straight). The rails used weighed 16 lb. per yard, in conjunction with 6-lb. light-steel sleepers. The loco-tractor weighed $4\frac{1}{2}$ tons and was fitted with a 35-hp. engine, using paraffin as fuel.

After two and a half years work the rubber tires of the tractor were in good condition, being worn down $\frac{1}{4}$ in. and evenly. A feature of the trial was the accuracy with which the driving-wheels aligned themselves to the setting of the steering bogie on the track: they always followed the spoor of the wheelways exactly. A simple device enables the loco-tractor to be readily converted into a road tractor, the change only occupying about half a minute. Although crippled and bent rails were used, the loco-tractor rode easily at 18 miles per hour and took 50-ft. curves steadily at 12 miles per hour. Attempts made to derail the tractor by running at excessive speeds around sharp curves were unsuccessful. A cloud-burst at Canada Junction washed away portions of the track, leaving holes a foot deep and piled up gravel and earth several inches deep over the track, but the loco-tractor and trailer passed over these obstructions without difficulty.

Mineral Resources of Queensland

*Queensland, the second largest of the six States that comprise the Australian Commonwealth, occupies the north-eastern portion of the island-continent. It has an area of 670,500 square miles (or 429,120,000 acres), nearly one-fourth the total area of Australia. It is two and a half times the size of Texas, over three times as large as France, and more than ten times as large as England. The population is estimated at 700,000, or about one person to the square mile.

Mineral production has from the beginning been a notable source of Queensland's income; in fact, many of the large cities and towns owe their origin to mining camps, and the State is still dotted with the remains of abandoned diggings, where mining towns of 10,000 to 15,000 inhabitants have been succeeded by farming or pastoral villages with 200 or 300 residents. Gold was the first of the minerals to be exploited, and its production showed an accelerating increase from 111,589 oz. in 1868, the first year in which it exceeded 100,000 oz., to 676,027 oz. in 1900, since when production has been steadily declining, and at present is under 150,000 oz. The prohibition of the export of gold during the War had an almost fatal effect on the gold-mining industry, partly offset by the comparatively recent permission to the Gold Producers' Association of the Commonwealth to export a certain amount of newly mined gold. Most of this new gold has been exported to the East, but at the end of October 1920 large shipments were made to America, in order to create exchange for commercial purposes.

Labor and other costs have become so high as to make the poorer mines unprofitable, but with a return to pre-war conditions—if such a return ever occurs—gold production in Queensland should increase, as the low-grade mines have by no means been exhausted. There are 10 main goldfields in the State, but gold is also found elsewhere. As the production of gold declined that of other minerals increased. The output of copper, which was valued at £23,040 (\$112,125) in 1900, reached £2,087,751 (\$10,160,040) in 1918. Mount Morgan, which as a gold mine enriched its owners beyond the dreams of avarice, now receives more from copper than from gold. The copper mines at Cloncurry, in the heart of northern Queensland, are more important even than those at Mount Morgan, and produce more than half the total output of the State. Smaller mines are being operated at five other places. Copper and gold are generally found together, and silver frequently with them. The State's silver production is not large, being in 1918 152,499 oz., as contrasted with the record output of 1,162,276 oz. in 1908. There are five important tinfields in the State, their total production in 1918 being valued at £251,755 (\$1,225,166), compared with £496,766 (\$2,417,512) in 1907, the record year. Zinc is produced near Stanthorpe, in south Queensland, in conjunction with lead and silver, and at Herberton.

Queensland possesses extensive iron deposits, which have, however, been mined chiefly for fluxing material to be used in connection with the reduction of gold and copper ores. The present State government has elaborated plans for the mining of iron on a large scale and the erection of government steel and iron works, but has so far been unable to raise the necessary funds. Sapphires, mined between Rockhampton and Longreach, and opals, found in many places, are the most profitable gems produced; but the occurrence of gem stones is so widespread as to promise a great future income to the State. At present the industry is undeveloped, mining being done largely by casual labor, which takes to it only when work on the pastoral stations is slack.

ACCORDING to the 'Queensland Government Mining Journal', the Gold Producers' Association of Australia reports the shipment of 300,000 sovereigns to America on November 24 and 300,000 sovereigns on December 22, completing the sale of 700,000 sovereigns already announced. Apart from these shipments, a small quantity of gold has been sold in Hongkong, and it was expected that 10,000 oz. of bar-gold, shipped to India, would also be sold. An interim distribution, amounting to £542,646 on account of premiums obtained on gold sold during the previous half-year, was made on November 26, and was paid to shareholders in the several States as follows: Western Australia, £346,335; Victoria, £88,464; Queensland, £84,370; New South Wales, £17,744; Tasmania, £3626; Papua, £1698; South Australia, £409; total, £542,646. The board expected to be able to make a further interim distribution in January in respect of the last half-year's premium income.

*Abstracted from 'Commerce Reports'.

Unstainable Steel

By J. H. G. Money Penny

*The commercial utilization of the non-corrodible properties of steel containing about 12% of chromium may be regarded as one of the outstanding events in the metallurgical world during the past decade. Steel, the most widely used metal, unfortunately corrodes easily, and precautions have to be taken to protect it, especially in exposed positions. The production of a type of steel possessing resistance to corrosion has obviously a great future, and one may safely say that, as yet, only the fringe of the possibilities has been touched.

Unstainable steel possesses notable air-hardening properties. A sample one inch or so in diameter, if allowed to cool freely in the air from 900°C., will have a Brinell hardness number of the order of 500. The capacity of the steel to harden increases with the temperature to which it is heated. In other words, the speed of cooling necessary to harden the steel becomes slower as the temperature to which it is heated rises (providing the latter is, of course, above the carbon change-point); also, slower rates of cooling are necessary to soften or anneal the steel when cooled from progressively higher temperatures.

The property of air-hardening is useful in a steel. Apart from the obvious fact that less drastic methods of quenching are required (with the attendant lessened danger of cracks, warping, or other undesirable attributes of water-quenching), the slower rate of cooling necessary to harden the steel permits samples of large section to be hardened throughout. It also lessens the danger of soft spots due to retarded quenching. Anyone who has had experience in producing a glass-hard surface over a considerable area in an article made of ordinary carbon steel will appreciate the meaning of the last sentence. Owing to its air hardening properties, however, the steel requires care during the course of its manufacture. Billets, bars, forgings, or stampings are usually heated to at least 1000°C. before any operations are carried out, and if the material after being worked is allowed to cool on the shop floor it will, when cold, be in the hardened condition and will be as liable to crack if rapidly or unevenly heated again as any hardened piece of tool steel. Being hard, it will require softening before any chipping, filing, or machining can be done. These troubles, however, may be avoided by allowing the forged, rolled, or stamped article to cool slowly over the range 800°–600°C. in order that the carbon change may take place and the steel thus become soft.

Unstainable steel is tempered in the same way as ordinary steel, but higher temperatures are required. A corresponding series of temper colors are formed at the higher temperatures necessary to soften the steel. For example, the following colors were obtained, at the temperatures indicated, on a hardened sample of the steel:

Straw	300°C.
Brown	400°C.
Reddish purple	500°C.

Light blue	600°C.
Bluish violet	650°C.
Grayish violet	700°C.
Gray	750°C.

Unstainable steel has its maximum resistance to corrosion when in the hardened condition. It is then practically unaffected by exposure to moist air, fresh or salt water, or to such organic acids as occur in fruits. Samples buried in soil for three months have retained their original polish, and others have been immersed in vinegar or salt water for days without showing the slightest signs of attack. Tempering the hardened sample up to about 500°C. does not affect its resistance appreciably. Such tempering has also little effect on its hardness. Tempering at higher temperatures lowers the resistance to corrosion, but even in the soft condition the metal is only slowly attacked. Such soft material, for example, is stained by vinegar, but a sample weighing 60 gm. only lost 0.004 gm. after three weeks immersion. A sample of nickel-chrome steel hardened and tempered so as to give the same tensile strength lost during the same time 25 times as much.

Nitric acid, strong or weak, does not dissolve unstainable steel either in the hard or soft condition, nor is the steel attacked by concentrated or dilute solutions of ammonia, nor in a moist atmosphere containing ammonia fumes. Sulphuric and hydrochloric acids attack it readily; a 10% solution of the latter in alcohol forms a convenient etching reagent for microscopic work. Dilute solutions of sulphuric acid, at ordinary temperatures, attack unstainable steel considerably faster than ordinary mild steel.

The opinion has been held that the non-corrodible properties are only obtained when it is highly polished and that they are then confined to the surface. This is not correct. It is well known that metals in general have an increased tendency to corrode after they have been cold-worked. Unstainable steel is no exception. Turnings of this steel are in a highly distorted condition and hence will rust. Similarly, the surface of a bar from which heavy cuts have been taken is distorted and is more likely to rust than one from which a fine finishing cut has been taken. A ground or polished surface will be still more immune. That polish, however, is not essential is shown by the resistance to corrosion of a fractured surface which has been obtained without distortion.

In addition to its resistance to corroding influences, unstainable steel does not scale to any extent when heated at any temperature up to 800°–850°C. A sample heated for seven days in the range 700°–825°C. lost 0.7% of its weight, whereas a piece of ordinary steel heated with it lost 17%.

The suitability of any new type of steel for use in engineering work of any description is largely judged by its behavior under mechanical tests. A short description of the results of such tests will be of interest. After oil or air hardening from a temperature of 900°C., followed preferably by slight tempering at 200°–400°C., unstainable steel has mechanical properties comparable with those of the well-known '100-ton' air hardening nickel-

chrome steel. When tempered in the range 650–750 °C., it gives tests highly suitable for many engineering purposes. The values obtained depend on the composition of the steel, but in general are in the following ranges:

Yield point	30–55 tons per square inch
Maximum stress	45–65 tons per square inch
Elongation	15–28 %
Reduction of area	35–65 %
Izod impact	25–70 ft.-lb.

Tempering in this range of temperature (650–750 °C.) is also interesting commercially in that the hardness, and therefore the tensile strength, only falls very slightly as the temperature increases. When a number of articles has to be tempered to produce a given tensile strength, a wide range of tempering temperature is permissible—obviously a desirable thing commercially. On the other hand, the hardness falls very rapidly in the range 550°–650 °C., and the difficulties of tempering in this range are correspondingly great.

During the War the great bulk of the unstainable steel produced was used for aeroplane valves. Its value for this purpose lay, apart from its non-sealing property, in its superior strength at red heat. The exhaust valves, especially of some of the large aero-engines, frequently reach a temperature of 750 or 800 °C., or even higher, and it is necessary that the valve should have sufficient strength at such a temperature to secure that the stem does not elongate during running. Actual tests obtained on testing mild steel and unstainable steel at high temperatures gave the following figures:

Tensile strength at	Mild steel	Unstainable steel
600 °C.	11.84	24.24
700 °C.	6.8	12.08
800 °C.	5.04	6.64
850 °C.	4.12	6.64

By increasing the carbon content of unstainable steel, still higher values may be obtained: 15–17 tons at 700 °C. and 7.5–8.5 tons at 800 °C.

The development of the uses of unstainable steel was largely held up during the War, because practically the whole of the steel made was used for war purposes. It may be confidently expected, however, that the near future will bring about a noticeable development in the number and variety of its applications. It will also be found that unstainable steel is not one steel but a group of steels. Just as in the far-off days steel was regarded as a hard product of iron, and little or no attempt was made to grade it into harder or softer varieties, so at present unstainable steel is to most people a product having only one distinct set of properties, many regarding it solely as a special type of cutlery steel. In times gone by, as the use of steel became more general, it was realized that by varying the content of carbon or manganese, steels of widely different intrinsic hardness could be produced, and for each purpose some definite temper of steel was best suited. In the same way, as the use of unstainable steel becomes more general, it will be found that products of different intrinsic hardness (corresponding to the varieties of ordinary steel) can be produced, all of them

having the distinguishing property of great resistance to corrosion, but varying among themselves as soft or mild steel differs from file steel. For each use of unstainable steel there will be an optimum temper.

THE HOMESTAKE MINING CO.'S NEW SOUTH MILL, will be situated about 2000 ft. east of the Ellison shaft, on one side of the ridge immediately south of cyanide plant No. 1, which now treats the sand from the Lead stamp-mills, according to R. G. Wayland, the assistant superintendent, who writes in the 'Pahoa Quarterly'. The reason for the construction of this mill is that the site of the 220-stamp mill has been undermined and the equipment may have to be abandoned. The South mill will be connected with the Ellison ore-bins and the tramway by a steel trestle, a surface tramway, and a tunnel, so that ore may be hauled from either the Ellison or B. & M. shaft to either the new or old mills. On arrival at the South mill in cars the ore will be dumped into a steel bin having a capacity of 6000 tons, and be fed through Challenge feeders and revolving-screen feeders to 120 stamps weighing 1550 lb. each, arranged in two rows of 60 stamps each, back to back. The stamps will have ½-in. screens, and the product will join the undersize from the revolving-screen feeders and will flow to six diaphragm cones, one cone to each twenty stamps. The spigot discharge from each of these cones will be re-ground in a rod-mill, 5 by 10 ft., in closed circuit with a 6-ft. Dorr classifier, making six units in operation, with a spare unit in reserve. The classifier overflow, which is to be an 80-mesh product, will join the overflow from the diaphragm cones and will pass over 12 amalgamating plates, each 9 by 12 ft., and arranged in two rows so that each pulp stream flows over two plates. The pulp then flows to four diaphragm cones, whose underflow is to be re-ground in two tube-mills in closed circuit with two Dorr classifiers, the product flowing over plates to eight 7-ft. cones. The overflow of the four cones above the tube-mills will flow to eight 10-ft. cones, whose underflow will pass to the eight 7-ft. cones mentioned above. The underflow of the eight 7-ft. cones is to be carried by launder to cyanide plant No. 1, where the sand-slime separation is completed. The overflow of the 16 lower cones will flow to a new tank-house containing three 32-ft. Dorr double-tray thickeners, the underflow going to the sand-slime separation plant and the overflow either being returned to the mill or used as wash-water in cyanide plant No. 1. The capacity of the new South mill is estimated to be 1800 tons per day, and the mill is so arranged that 20-stamp units may be added until the capacity has been doubled. All the work is under way and practically all the equipment has been purchased or contracted for. Much of it has been installed, but none of it is in operation.

COPPER PLATES, used for the amalgamation of gold, are usually given a coating of silver which varies in amount from one to three ounces of metal per square foot of copper. A plating of this thickness is found to result in a minimum absorption of gold.

Steel Rails as Ball-Mill Lining

By E. B. Morse

The maintenance of the lining of the shell has always been one of the larger items of cost, and accordingly one of the serious problems in the operation of ball-mills. In the last three years I have had an unusual experience in the operation of an important small copper-milling plant in the North-West. Owing to the fact that good steel eastings have been uncommonly expensive, as well as hard to get, in recent years the maintaining of good lining for ball-mills has been a particularly troublesome problem. Under such conditions we were almost compelled to experiment with second-hand railroad steel as shell-linings. During a long experience in tube-milling at a number of cyanide plants, I had on several occasions used steel rails to patch partly worn or incomplete sets of El Oro lining with satisfactory results.

There were two ball-mills at our copper-concentrating plant: an early-type Allis-Chalmers ball-granulator, 6 ft. diam. and 5 ft. long, used as a preliminary grinder; and a ball-mill, made by the Colorado Iron Works, 5 ft. diam. and 6 ft. long, used for re-grinding, following concentration on tables.

The Allis-Chalmers mill had been purchased second-hand during the War. It was built before its designers had passed the experimental stage in ball-mill construction. There were two sets of shell-lining plates on hand. While they were of good material, they were so thin that some of the plates would be worn through in less than two months.

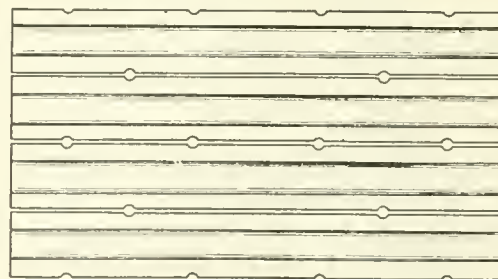
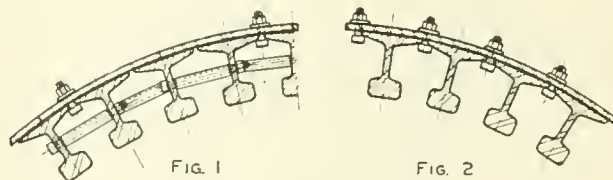
A new manganese-steel lining was ordered from the manufacturers about two weeks after the signing of the Armistice when conditions at the factory were still decidedly unsettled. Although the complete lining cost \$3600 and the shell-lining alone cost more than \$2400 it lasted only a trifle over three months. The composition of the metal was chemically right, but the molders had gone wrong in their re-heating treatment, leaving large, porous, spongy, coarse-grained patches, which lasted but little better than the proverbial 'snow-ball'. At that time it took from 60 to 90 days to get plates from a factory, so there was no time to get a new set. There were enough partly worn plates from preceding sets from which to select a lining that would last about a month. It was then that we decided to try a ribbed lining made from railroad steel for our ball-granulator.

The regrinding mill intended for fine grinding and charged with small balls was lined with thick white-iron plates. A set of these lasted about five months, making a comparatively economical lining. We had already planned to try steel rails for a shell-lining in the regrinding mill. Owing to the unexpected circumstance of the sudden giving-out of the lining for the primary mill,

steel rails were adopted as a shell-lining in both mills at the same time.

The change was made during a holiday shut-down between Christmas and January 1919. We selected 50-lb. rails because they were $3\frac{1}{2}$ in. wide at the base. This permitted spacing three of them at equal intervals between the bolt-holes already in the shell of the granulator, which happened to be spaced at 12-in. centres.

Sixty pieces of 'relay' steel rails cut in 58-in. lengths and punched with suitable bolt-holes were procured from Hofens Steel & Equipment Co., Seattle, for \$220. Enough standard $\frac{7}{8}$ -in. and $\frac{3}{4}$ -in. machine-bolts to fasten them to the shell were obtained from a local hardware firm for about \$30, so that the first cost was about one-tenth that of a set of manganese steel. Less labor is re-



quired to renew the rails than was needed for replacing the old plate-lining.

A steel-rail lining as now used lasts about five months in the first or coarse-grinding ball-mill. The first set has not yet worn out in the regrinding mill although it has had 10 months actual wear. When the rails are fastened according to the latest method of bolting them to the shell it is expected that a set of rail-lining will last 18 months.

The feeding of 5-in., 4-in., and $3\frac{1}{2}$ -in. balls has been tried in the granulator without a noticeable difference in the rate of abrasion. The coarseness and hardness of material being ground seems to have more to do with wear of lining than the size of balls, that is to say, within the practical limits.

I will give the evidence from our experience supporting this conclusion. We found all sizes of balls distributed quite evenly through the charge. It is self-evident that the coarsest feed will be nearest the feed-

end. The lining does not last much more than half as long at the feed-end as at the discharge end of the granulator. These steel rail ribbed linings pick up a load of suitable sized balls from the grinding charge in much the same way as when the widely known El Oro linings are used in pebble-mills.

In our experience, when using $3\frac{1}{2}$ and 4-in. balls, with the entire feed cracked by rolls to less than one inch about three months is required to wear the head of the rail down to the web, on the feed-end. The smaller balls then commence to fall out and are replaced by larger ones. The web, being soft, is battered down around the larger balls, thus holding them in place between the rails until the heads are more than half worn away, when they fall out. From this time on the rails act as small wave-type liners until the bolt-head is worn out. It is then time to replace them with new ones. At the end of five months the head of the rail nearest the discharge-end is not over half worn to the web; in the middle it is worn to the web, and at the feed-end it is worn to the base, the web being completely consumed.

By changing ends and resorting to some patching it would be possible to get an additional six weeks of wear from a set of rails, but when a new set can be had for \$220 much patching does not seem worth while. A new set can be installed as quickly as an old one can be shifted. The practice was to grind everything to pass a $\frac{1}{2}$ -in. screen in the first ball-mill. The re-grinding mill reduces the material to 95% through a 100-mesh screen for flotation. Both 2-in. and $2\frac{1}{2}$ -in. balls have been used in the re-grinding mill. Good results have been obtained by adding daily 75 lb. of flint pebbles when we did not have sufficient power for a full load of balls for the overflow mill; they added bulk without increasing the weight to the same extent. Balls are $2\frac{1}{2}$ times as heavy as pebbles to fill the same space. The same difference in wear in the two ends of the re-grinding mill was not observed as had been noticed in the first ball-mill. Nine months were required to wear out the head of the rail in re-grinding mill.

In the first experiments, balls were placed between the rails when they were put in the mills, and concrete poured around them. When the granulator was re-lined it was allowed to pick up its own filling from the charge, with just as good results.

When installing rail-lining for the first time we did not wish to drill additional holes in the shell until sure of our ground; accordingly rails not bolted directly to the shell were fastened to the other rails by cross-bolts with spacers made of pipe encircling them, as illustrated in Fig. 1. This method was as good as any while the cross-bolt lasted, but the life of the liner was about 25% longer when all rails were bolted to the shell as shown in Fig. 2. This method now is employed.

Fig. 3 shows the present method of punching half-holes on the edge of the base of each rail. The bolt-head straddles two of them. Four half-holes are punched to match the original bolt-holes in the shell. Two half-holes are punched in the other places to fit the additional holes

that we drilled. The lining for doors is cut to fit with an acetylene torch. Rails are cut in two lengths for lining the regrinding mill. While this lining for the granulator cost only one tenth as much as our manganese steel set, it lasted considerably longer. I do not wish it understood that I claim it to be 10 times as efficient as the best manganese-steel lining for several reasons. With good factory conditions it is not unusual to get a manganese shell lining for \$2000 that will last for six or eight months with hard rock, coarse feed, and large balls.

The cost of the balls that collect between the ribs and thus protect both the rail and the shell of the mill until they themselves are worn out is also chargeable to the cost of lining. A set of steel rails for the regrinding mill costs less than half the price of a set of white-iron castings and it lasts three times as long.

A claim that the steel rails in the first ball-mill have twice the efficiency of the ordinary manganese-steel lifter-type of liner seems to me to be conservative. The same liner has easily three times the efficiency of white-iron plates in regrinding.

No difference in capacity has been detected. We have contemplated using in the next set, for the granulator, a higher rail in every third place, thus giving a lifter-bar effect while it is new. Of course the head of this rail will wear more rapidly than the others, but they should in turn act as lifters while the web of the larger rails is wearing down. Nothing but a trial will tell what the result will be.

STOSES of the No. 3 mine of the Ray Consolidated Mining Co., at Ray, Arizona, which extend under the creek and the surface equipment of No. 2 mine, are filled with waste and further packed with sand to prevent cracking and settling of the capping, states a Bureau of Mines pamphlet. The ore and capping are friable and readily cave. In order to keep the capping from cracking, the filling must completely fill the openings. Undue settling of the filling is prevented by flushing sand in at the top of the stope to fill the interstices in the waste. This is done as soon as a panel is finished; sand may also be run in while the panel is being filled. The worked-out stopes are carefully watched, and if the filling settles, more sand is used at the top to keep the openings tightly packed. The sand used, the fineness of ordinary building sand, is tailing from the company's concentrator at Hayden, and is brought to the mine in ore cars. The dry sand is dumped from the ore cars into a separate raise and trammed by hand in 1-ton mine cars to the top of the stopes. After being emptied from the mine cars the sand is flushed into the stopes by means of a hose. Water for this purpose is piped from the pump column in the shaft: the small amount used readily drains through the filling to the level below, and finds its way back to the sump for the mine pump. The water is clear after leaving the stopes. No bulkheads are used at the bottom of the stopes. The mine is divided into sections by concrete bulkheads for protection in case flood waters from the surface should enter the mine.



VACANCIES IN BUREAU OF MINES

The Bureau of Mines, through the Civil Service Commission, announces competitive examinations to fill a number of vacancies as follows: supervising mining engineer, \$4000 to \$5000 per year; mining and metallurgical engineer, \$4000 to \$5000 per year; mineral technologist, \$2400 to \$4000 per year; illuminating-gas engineer, \$3240 per year; and assistant refinery engineer, \$2760 to \$3000 per year. The supervising mining engineer is to take charge of one of the mining experiment stations and is to supervise investigations and disseminate information to improve conditions in the industry. The mining and metallurgical engineer will act as special investigator and technical assistant to the Director of the Bureau and especially must bring into the work the viewpoint of the practical and operating engineer. Further information may be obtained from the various offices of the Commission. Receipt of applications will close April 26, 1921.

MEXICAN OIL PRODUCTION

Developments in the oilfields of Mexico are being keenly watched by producers in this country. While they take the attitude that the menace of salt water has been exaggerated, they do not believe Mexican production in the future will continue to show the growth of the last few years. So far as salt water is concerned they realize that it is a part of the business and its occurrence becomes serious only when new production is not obtained in sufficient quantity to offset the loss through invasion of water. Failure to perform drilling in the past on a scale sufficient to replace production lost is partly the fault of the companies themselves and partly due to unfriendly attitude of previous Mexican authorities in refusing to grant drilling permits to open new fields.

Any substantial falling off in Mexican production will be immediately reflected in higher prices for domestic crude and refined products. It is this situation which particularly interests American producers, who are already storing oil in this country not only because of its prevailing low price, but the probability that American fields will be called upon to make up any drop in Mexican output. Mexico has been the largest contributor of crude oil to American refineries, with exception of American fields. Mexico's production has grown almost five times as fast as that of the domestic fields. Thus this country was producing oil for 50 years, 1860 to 1909, inclusive, before it attained a production approximating the 185,000,000 bbl. yielded by Mexican wells last year. The real development of Mexican fields did not start until 1910, eleven years ago.

The importance of Mexico's contribution to our oil supply may be realized from the fact that our imports from that country of about 106,000,000 bbl. in 1920 was slightly larger than the output of California. Assuming refiners obtained a yield of 10% in gasoline from oil imported from Mexico in 1920, the resultant yield of 445,000,000 gal. was equivalent to 9% of 4,870,000,000 gal. of gasoline produced by domestic refineries in 1920.

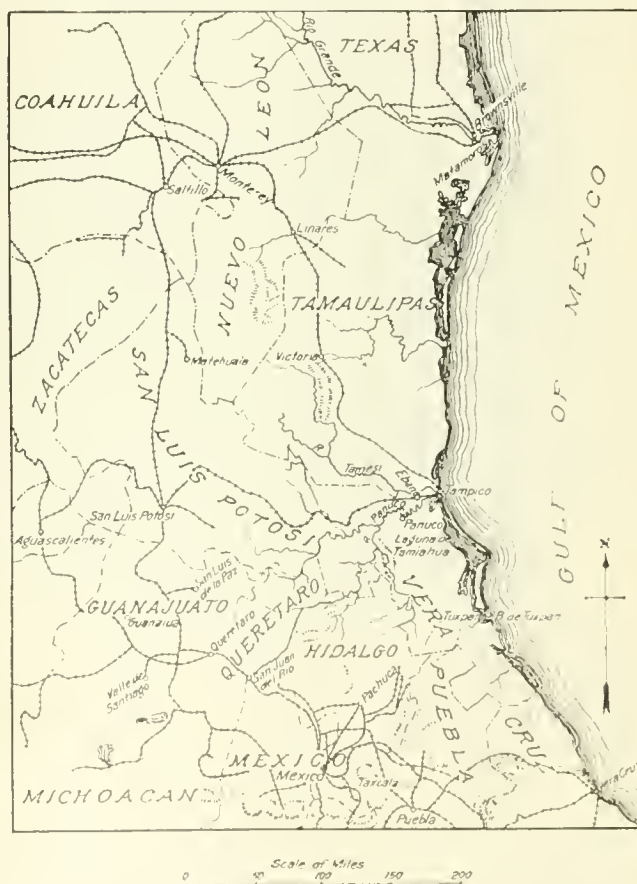
Total domestic and foreign consumption of gasoline in 1920 was approximately 4,640,000,000 gal., so that 230,000,000 gal. was carried to storage. Were it not for Mexican

imports and the gasoline they yielded, there would have been a deficit of 215,000,000 gal. in our supply.

AFFAIRS OF THE VANADIUM CORPORATION IN PERU

Development work at the property of the Vanadium Corporation of America at Mina Ragra in the Peruvian Andes has disclosed ore containing more than the originally estimated 28 million pounds of recoverable metal. In addressing the stockholders J. Leonard Replogle, president, says:

"During the War we found it impossible to make necessary



Principal Oil-Producing Districts of Mexico

improvements at the mines. As soon thereafter as possible we began to make such improvements, particularly with reference to transportation, the principal limiting factor. The only means of transporting ores from the mines at Mina Ragra to Rieran, on Cerro de Pasco railway, 28 miles, was by llamas, which proved inadequate. A narrow-gauge railroad was built to the western shore of Lake Pun Run, over which ore is transported to another narrow-gauge road, now in process of completion, which connects with Cerro de Pasco railway at Rieran. Other improvements include resumption of the construction of a 500-kilowatt hydro-electric plant and a change in method of reducing ores to eliminate the costly aluminum process and substitute the more eco-

nomical electric reduction. Quantity production with the latter process was not reached until December, due to industrial conditions. A leaching plant to treat portions of ore for certain grades of ferro vanadium, has also been installed.

Shipments from Peru by December had reached approximately six times the monthly average obtained prior to 1920. For several years it had been noted that waters from the mine at Mina Raura were a brilliant green, indicating the possibility of containing vanadium. As a result of experiments a method of precipitation has been evolved which produces a residue that upon analysis shows 2% to 30% V₂O₅. Appropriate equipment for treatment of these waters is being installed, and during the coming year a handsome revenue from vanadium thus recovered may be expected.

FELLOWSHIPS IN MINING AND METALLURGICAL ENGINEERING

The Cooperative Department of Mining Engineering of the Carnegie Institute of Technology offers two fellowships in Mining Research, and two in Teaching and Research, in co-operation with the U. S. Bureau of Mines. Fellowships are open to the graduates of universities and technical schools who are properly qualified to undertake research investigations. The value of each fellowship is \$750 per year of ten months. Fellowship holders are required to register as graduate students and become candidates for the degree of Master of Science unless an equivalent degree has previously been earned. The purpose of these fellowships is to undertake the solution of problems in mining and utilization of fuels which are of special importance to the Bituminous Coal Industry. Fellows are not permitted to accept any kind of employment for pay during the ten months period of their appointment. Applicants should send a copy of their collegiate records from the registrar's office of the college where they have been or will be graduated. They should also state their professional experience and give the names and addresses of at least three persons who are familiar with their character, training, and ability. Applications are due not later than June 1, 1921, and should be addressed to Cooperative Department of Mining Engineering, Carnegie Institute, Pittsburgh, Pennsylvania.

CALIFORNIA LEADS AS AN OIL PRODUCER

According to statistics prepared by the American Petroleum Institute, California still maintains its lead over the other oil-producing States by a substantial margin. Oklahoma is second and Texas third. The following data show the average daily gross production for two recent weeks. The figures are in barrels.

	Week ending March 12	Week ending March 5
Oklahoma	275,405	279,705
Kansas	82,560	83,480
North Texas	72,815	71,720
Central Texas	125,550	127,000
North Louisiana	77,485	79,115
Gulf Coast	107,260	104,720
Eastern	119,500	120,000
Wyoming and Montana	56,550	56,940
California	328,000	331,000
Total	1,245,125	1,253,650

GOLD STOCKS IN THE UNITED STATES

There was a further large gain in the gold stock of the United States in February, according to the figures of the Treasury Department, the increase being \$63,404,121. This

compares with a gain of \$68,646,222 in January, making a total of \$132,050,343 for the first two months of the year.

Gold stock on March 1 stood at \$2,916,884 770, the highest point since September 1, 1919, when the stock was \$2,911,727,731. The increase in February was due to shipment from distant corners of the world, the bulk coming from England, France, Sweden, South America, and India. Imports of gold have also been substantial in the first two weeks of March. Increase in gold stock since the low of \$1,616,615,750 on May 1, 1920, to March 1, 1921, was \$270,269,020. Holdings March 1 were only \$205,002,673 below the record of \$3,121,887,443 on May 1, 1917. Weekly reports of the Federal Reserve Board indicate that a large part of gold coming into the country is finding its way into reserve banks. For the week ended March 11 the consolidated report shows a gain in gold reserves of \$24,816,000 to \$2,187,906,000. Gold reserves of reserve banks on January 2, 1920, were \$2,062,615,000, but owing to exports, principally to South America and the Orient, they fell to \$1,935,000,000 on March 26, 1920. By the end of 1920 they had increased to \$2,059,333,000. Since March 26, the low point of 1920, to the present, a period of slightly less than a year, gold holdings have increased \$252,906,000.

BRITANNIA CONCENTRATOR IN BRITISH COLUMBIA DESTROYED BY FIRE

Fire, which broke out on the evening of March 19 and raged throughout the night, completely destroyed the Britannia Mining & Smelting Co.'s concentrating plant at Britannia Beach, Howe Sound. It is supposed that the fire was started by a short-circuit in the electric wiring. Owing to the low price of copper, the mill was closed at the end of last November, and, as most of the fire-fighting apparatus was inside the building, it was some time before it was gotten into action. Flotation-oil stored on the third floor is supposed to have added to the speed with which the fire gained headway. The mill had a capacity of 2500 tons of ore per day. During the eleven months that it was in operation last year some 650,000 tons was crushed, yielding about 18,000,000 lb. of copper, 100,000 oz. of silver, and 4000 oz. of gold. Fortunately it was possible to confine the fire to the mill and part of the aerial tramway. The power-plant, which is one of the best equipped in the Province, and the compressor plant were uninjured. E. J. Donohue, superintendent of the mine, places the loss in the neighborhood of a million and a half, part of which is covered by insurance. W. R. Quigley, vice-president of the company, is quoted as saying that the plant will be re-built.

ALASKA

Cook Inlet.—The Willow Creek Alaska Mining Co. is assembling machinery and equipment in Seattle for shipment to its gold-mining property. The first cargo will include equipment for the hydro-electric plant, compressors, pipe, and a Holt caterpillar tractor for freighting. The power-plant will have capacity sufficient to operate a 500-ton mill in addition to supplying the mine. Milo Kelly and James N. McDonald will be in charge of the work.

La Touche.—The Girdwood mine, on Prince Williams sound, has been bonded on a royalty basis by W. A. Davis, the original owner. He says that a 150-ton mill has been constructed. The orebody has been opened to a vertical depth of 400 ft. The ore-shoot is described as being 1000 ft. long and in places 100 ft. wide. The average assay return is 2.6% copper. The Beatson mine of the Kennicott company is near by.

ARIZONA

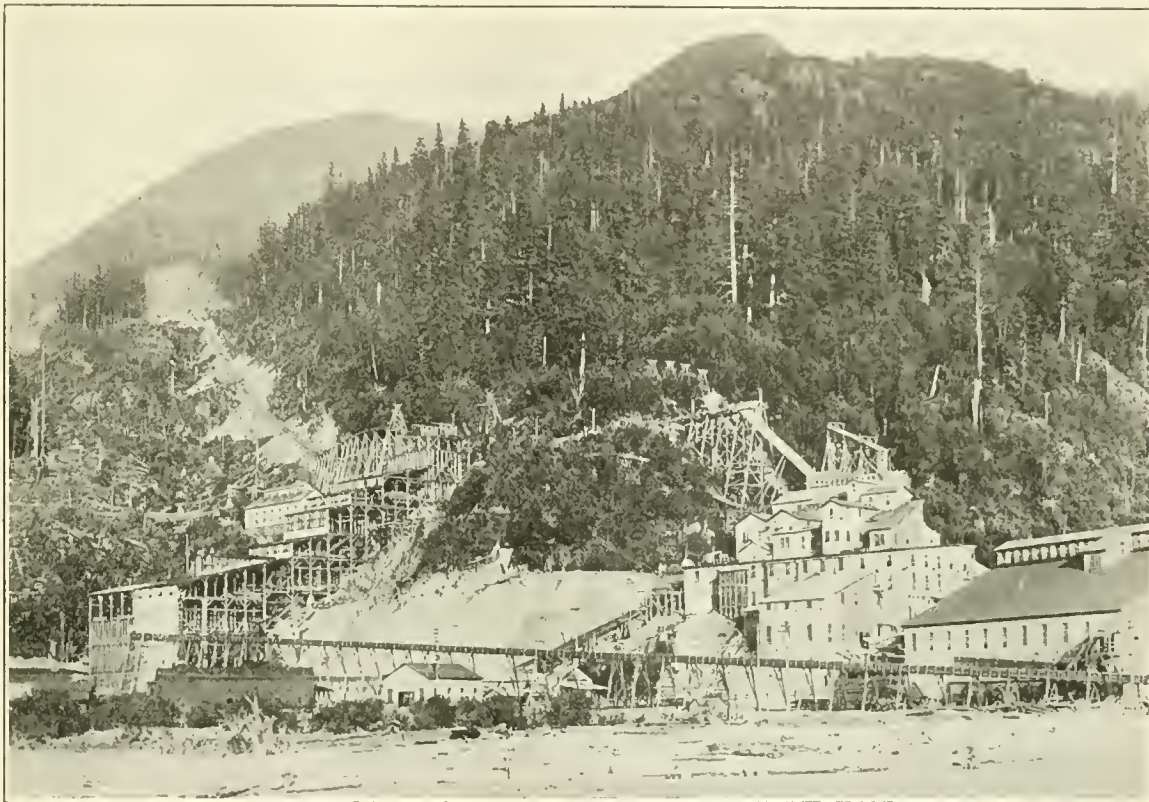
Globe.—The annual report of the Iron Cap Copper Co. shows a net operating income of \$268,877. After deducting for depreciation and depletion there remained a net loss of

\$142,270. At the close of the year net current assets amounted to \$824,263; liabilities, \$326,230; working capital, \$498,033. During the year 8,235,000 lb. of copper and 113,323 oz. of silver were produced from 91,326 tons of ore. The entire production of copper was sold at an average price of 17.44c. per pound. Three suits brought by the Arizona Commercial Mining Co. were dismissed for lack of jurisdiction during the year, but one suit for the alleged illegal extraction of ore is pending in the Supreme Court of Maine.

Kingman.—On March 28, Judge E. Elmo Bollinger of the Mohave County Superior Court rendered a decision in favor of the United Eastern Mining Co. in the litigation with the Tom Reed company. Ore valued at several million dollars, underlying the Big Jim claim, was awarded to the United

Placerville.—The Grit Mining Co. has purchased mill machinery, a compressor, and other equipment and will start erection of the buildings about April 1. The company is developing a rich quartz property near Spanish Dry Diggings. According to Walter P. King, president of the company, veins ranging from seven to eight feet wide are being developed, with high-grade ore in evidence. About 25 men will be on the payroll within 10 days.

Porterville.—A new company known as the San Joaquin-Portland Cement Co. has been organized to make cement in the San Joaquin valley. The company is capitalized at \$1,500,000. The company owns two valuable tracts of land in Tulare county, one situated about six miles east of this city, on the P. & N. E. railroad, and the other situated at



A Photograph of the Britannia Concentrator Taken During Construction. Destroyed by Fire on March 19

Eastern company on the ground that the lode apexed in claims owned by that company.

St. David.—A section of roadway two miles long is being built to skirt the danger zone of the new manufactory of the Apache Powder Co. Construction work on the plant is progressing rapidly and it will be ready to turn out powder within a few months.

CALIFORNIA

Bridgeport.—A 'stampede' to the Mason Pass district followed the finding of specimens of rich gold-quartz by Frank Daly and Charles Thomas. Fifty automobiles rushed to the scene and the surrounding territory was quickly located.

Grass Valley.—Bulkeley Wells, head of the syndicate reopening the Idaho-Maryland mines, Fred B. Farish, and Roy H. Elliott were here last week to formulate plans for further operations at the property. Lessees are producing some ore from the mines.

Jackson.—Thirty new men were employed at the Argonaut mine last week and as many more will be added at once. It is expected to have the mill in operation by May 15. The mine has been unwatered to a point 146 ft. below the 4300-ft. station.

Three Rivers, north-east of Exeter. The latter contains the larger deposit of lime rock said to be sufficient to keep a moderate sized plant running for 100 years. This deposit, however, is $7\frac{1}{2}$ miles from a railroad.

A modern plant, embodying the latest dust-saving devices, will be erected, its daily capacity to be 1000 barrels, with 150 workmen. The plant will be either at Three Rivers, Exeter, or Visalia. Shale deposits are found near the latter places. Members of the board of directors are: J. F. Humburg and Walter Buck, of San Francisco; F. Dean Prescott, Fresno; N. M. Ball, Porterville; R. F. Felchlin, Fresno; and Arthur King, Bakersfield.

Redding.—The experimental electrolytic zinc-plant of the Shasta Zinc & Copper Co., at Winthrop, is in operation. To date no trouble has been experienced. Ore-reserves at a depth of 1000 ft. are being increased.—Operations have been discontinued at the Mammoth Copper mine at Kennett. Recent mine development has not been entirely satisfactory and the condition of the market influenced suspension of operations. The Mammoth mine has produced 3,000,000 tons of copper ore.

Sonora.—A new body of rich ore is reported to have been opened in the Woods mine, north of Murphys, by Oslin &

Cuneo, who recently re-opened an old 2000-ft. tunnel, installed a milling plant, and are now operating regularly.

Sutter Creek. It is proposed to replace the present oil-burning equipment at the Central Eureka mine with an electrically driven hoist of sufficient capacity to hoist directly from the deepest workings. A new steel head-frame and larger skips are also planned.

COLORADO

Central City.—High-grade ore assaying \$400 per ton for first grade and \$110 for second grade, has been opened in the Fairchild mine in Russell Gulch and in addition a good grade of mill-ore averaging \$12 per ton is being shipped to the Polar Star mill in Black Hawk. —Lessees on the Gold Rock in Russell Gulch are mining and shipping rich gold-silver-copper ore. A recent shipment settled at \$75 per ton. —Ore sampling 75 to 100 oz. silver is under development in the Alaska mine of the Midwest Mining Co. with sacked ore, closely sorted, averaging 200 oz. per ton. —Colorado Springs and Milwaukee capitalists are financing the Black Hawk Consolidated Mining Co. recently incorporated, to operate mines in Gilpin county.

Cripple Creek.—Heavy production is being made this month; with the close of the present week in excess of 500 cars have been consigned to the Golden Cycle mill at Colorado Springs. The average is around 21 cars or about 650 tons daily. The grade shipped is between \$15 and \$25 per ton. Some ore is shipped to the smelters, the average grade of which is \$75. —The Hahnwald brothers, who own the Queen Bess mine on Tenderfoot hill, have arranged to operate through the Mollie Kathleen deep shaft. The mine is one of the most important properties on Tenderfoot hill and has produced considerable high-grade gold ore. —The Little May mine of the El Paso Consolidated company on the south-western slope of Beacon hill is again active under lease, and the ore is being sacked for shipment.

The orebody being developed at the 2450-ft. level of the Portland, has been proved in the north drift for better than 150 ft. with a width of 10 to 12 ft. The ore shipped as broken averages better than \$30 per ton, with rich streaks assaying 10 to 20 oz. gold per ton. In the south drift the ore is of a good milling grade. The drift has passed through six cross-veins all containing ore. The filled stopes in the Hidden Treasure section are to be tapped and the ore conveyed by underground tram to the Independence, to be there hoisted for treatment at the Independence mill. —The Modoc Consolidated, Cresson, and Portland mines continue to be the heaviest producers of the district.

Dillon.—The Mineral Point Tunnel & Mining Co., a Denver corporation, is driving a tunnel into its property in the Beaver Dam district of Summit county, six miles east of Dillon and east of Keystone on the C. & S. road. Ores in the old workings, mined from three distinct veins, contain gold, silver, and lead and shipments to date have ranged from \$40 to \$100 per ton. The tunnel now nearing completion will in addition to saving transportation charges, drain the property.

Kokomo.—Operations are shortly to resume on the Pearl Consolidated group on Chalk mountain, by the Kokomo Mining Co. Before operations ceased last winter a good grade of silver-lead ore had been opened. Plans for a mill have been prepared and it is reported by S. E. Davis, president, that mill-construction will be undertaken this summer.

IDAHO

Coeur d'Alene.—After being down for a few weeks, the Brady Development Co. has resumed work on the Olympic group. The property is situated between the Cleveland and the Tamarack and Custer. From the old Headlight workings, the company is running a cross-cut, which is now in 1450 ft. —Thirteen cars of ore shipped by the lessees from

the lower workings of the Western Union Mining Co. has brought returns of \$33,000. Of this amount the company receives 25% in royalties. Lessees in the upper workings have 50 tons of ore ready to ship. In the lower workings a contract has been let to cross-cut 200 ft. to a point where it is believed the main vein will be found.

Good looking ore has been struck in the New Caledonia property between Kellogg and Wardner, but it is not thought to be from the main vein. The cross-cut is now in about 400 ft. and it is believed it is close to the lode. —A contract to drive 50 ft. in the 1000-ft. adit on the property of the North Star Mining Co. has been let. It is expected to reach the vein opened on the surface.

Seventy-five tons of tailing per day is being handled by the three shifts working at the plant of the Hayes Tailing Co. at the mouth of Pine creek, according to Arthur Hayes, manager. The company is working tailing accumulated in the last 30 years from the big mines of the Coeur d'Alene, which has been deposited along the south fork of the Coeur d'Alene river. The feed averages 5 to 6% lead from which the company ships 200 tons of concentrate per month to the Bunker Hill smelter at Kellogg. The concentrate assays 25% lead and 20 oz. silver. The rich deposit is from two to three and a half feet thick.

Fair galena ore containing no zinc is coming from the Tyler Mining Co.'s lower tunnel. The tunnel is in 800 ft. and has 50 ft. to go to reach the point under the ore in the upper tunnel. —The Mullan Milling Co., which for the last year has been operating a lease on Government gulch a few miles west of Kellogg, has shipped over 3000 tons of concentrate and at present is turning out 225 tons per month. The ore is rich in silver, averaging 75 oz. per ton with 25% lead. —G. Scott Anderson, manager for the Big Creek Mining Co., is operating a mill of 75 tons capacity. The mill is producing from one to two cars of concentrate per week, said to average 100 oz. silver per ton. The ore contains gray copper and galena, differing materially in the general type of Coeur d'Alene ore in that the silver and iron predominate, leaving the lead an unconsidered factor. The mill is connected with the mine by a two-bucket aerial tramway.

Orofino.—Machinery is being installed in the Bloyer Mining Co.'s property, including seven claims on Poor Man's creek in the Pierce mining district, 26 miles from here. Operations will be started this spring.

MICHIGAN

Houghton.—An order has just been placed with the Michigan Smelting Co. for 800 tons of Copper Range copper for export. The shipment, which will go forward about April 1, will require 20 cars. It will go in two lots of 300 and 500 tons. It is not known here to whom the metal eventually will be delivered but it is presumed Germany will take most of it. This is the biggest order for copper for export received here since before the War. It is equal to about a month's production by Copper Range on the present basis of operation. Copper Range recently made a shipment of 175 tons of special order copper for Germany. The cakes are intended for the casting of locomotive fire-boxes. It is understood German locomotive works are engaged in filling large orders for Spanish railways.

Practically the only metal of any consequence sold by Quincy is going to the Dollar Bay wire mills. One more furnace has been closed down at the Quincy smelter and a day and night shift laid off. The plant now has three furnaces idle, leaving only the largest and newest in operation. Shipments from the mine to the mills have dropped off somewhat owing to the loss of miners. The daily tonnage has slumped from an average of 3000 tons to 2800. An unusually good grade of rock is now coming from No. 8 shaft, averaging even better than that from No. 6. Considerable mass is being hoisted from No. 2.

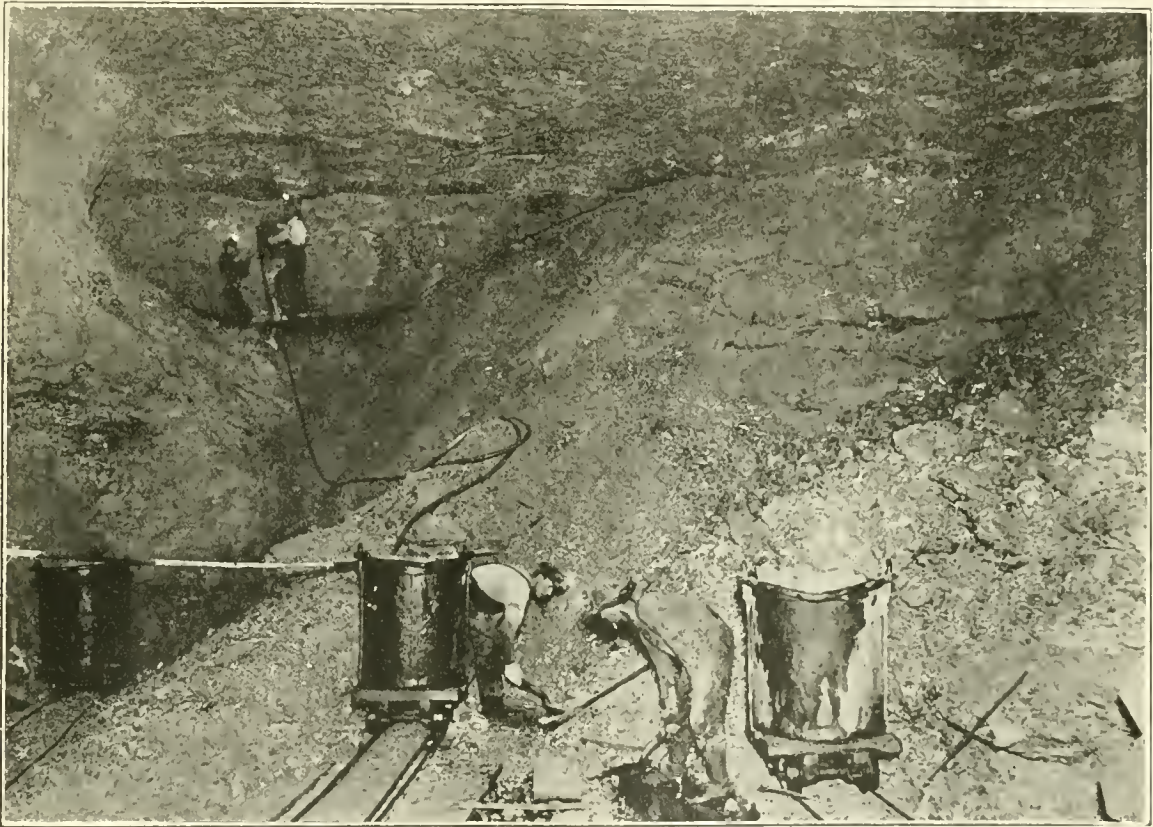
The cross-cut east from the Red Jacket shaft of Calumet

& Hecla, at the 81st level, which has penetrated the foot-wall of a vein tentatively identified as the Kearsarge lode, has just gone through a much disturbed area. The formation consists of a series of traps and flows with copper stringers, the whole being 65 ft. in width. This disturbed ground is 1100 ft. from the shaft. The formation is different from that of the Kearsarge wherever else it has been opened, inasmuch as the Kearsarge vein usually is well defined and runs from 12 to 14 ft. in width. However, it is possible the cross-cut has hit the lode where there has been more or less of a roll or flattening out process and that further work will reveal a more regular formation. The cross-cut will be extended at once farther into the foot-wall to determine positively whether it is the Kearsarge foot, which it resembles. There are certain crystals and other characteristics of Kearsarge foot-wall rock by which it can be identified. The one

Whitchall.—A 16-in. vein of sulphide ore averaging \$40 in gold and silver is said to have been found at the Gold King & Queen mine recently leased by J. W. Holmes, Louis McLaughlin, and H. G. Klenzie. Iron ore from the district is being shipped to the smelter at East Helena for fluxing purposes.

MISSOURI

Joplin.—Unusually rich lead ore has been opened by Barnes & Young in the old Sawyer mine near Webb City. The ore was found on the 150-ft. level; the extent of the deposit has not yet been fully determined.—W. J. Stroup and associates will re-open under lease a mine on the Brooks land near Picher.—The smelter of the Eagle-Picher Lead Co. at Galena, Kansas, has resumed operations for the first time since last December. Six furnaces will be operated four days per week and will give employment to 100 men.



A Characteristic Slope in a Lead-Zinc Mine in the Joplin District

reliable test would be to continue the cross-cut to sandstone which is known to parallel the Kearsarge vein for its entire length, 180 ft. east. If the sandstone were found there would be no further question of the lode's identity.

Six heads are being used in the stamping of Mohawk and Wolverine ore, four in the Mohawk mill and two in the Wolverine plant. Mohawk has brought its tonnage up to 2700 tons per day while Wolverine continues to ship 1000 tons. Mayflower reports the vein still showing in the roof of the east cross-cut about 300 ft. from the shaft at the 1700-ft. level. There are evidences it is the Mayflower lode which the management has been steadily seeking. In the west cross-cut the vein matter recently entered has been passed through. Both cross-cuts will be continued.

MONTANA

Helena.—A. V. Jordan and associates will erect a small mill to treat the material in the dump at the old Franklin mine in the Scratch Gravel district. The plant will have a capacity of 20 tons of silver-lead ore which averages \$6 per ton.

NEVADA

Goldfield.—Work done during the winter by the Allied Mining & Milling Co., in the Railroad Springs district, south of Goldfield, consisted of extending the east drift on the third level 50 ft., raising 35 ft. from the drift; drifting 15 ft. west and raising 10 ft.; drifting 35 ft. east on the first level and raising 10 ft. The concentrator is to be started April 1 or shortly after on 1200 tons of ore that has been broken during the winter.

Hornsilver.—The ore-shoot from which \$250,000 to \$300,000 worth of ore was shipped from above the 400-ft. level of the Dunfee shaft of the Orleans has been entered at 580 ft., where there is exposed a shoot 16 ft. long, 10 ft. high, and 8 ft. wide, without the limit being reached in any direction. This is considered of great importance by Tonopah and Goldfield engineers, who are of the opinion that the ore will be found continuous to the 400-ft. level, where it was lost several years ago at a fault. Work is being continued to determine the size of the ore-shoot and shipments of ore assaying 3 oz. silver and 1½ oz. gold have been started through

Stonewall, 16 miles distant. The find was made in the Dunfee inclined shaft, which is 500 ft. from another, the Orleans, in the same vein.

Las Vegas. Further details of the sale by Las Vegas men of a borax deposit near Muddy Peak, north-east of here, to the 'Horax' Smith interests, show that the deposit was sold to the West End company, one of the big silver mining companies in Tonopah in which Smith is interested. The purchase price is reported to have been more than \$250,000, a part of which has been paid. The deposit is said to be 3000 ft. long and 24 ft. wide and the indicated tonnage exposed is 500,000. The borax is in the form of the colemanite, a hydrous borate of calcium, similar to that found in Death Valley. Shipments of the higher-grade material are to be made 18 miles to the railroad and a calcining plant is to be built for treatment of the lower grade.

Silver Horn.—A big tonnage of silver ore is being opened in the Silver Horn, which is being developed by Weir Bros., New York brokers. Silver Horn is near the Bristol district, north of Ploche. It is reported that 300 to 500-oz. ore is being sacked and that several wide shoots have been exposed that assay 20 to 30 oz. The ore has a small gold content. Ore is reported to have been found for 600 ft. on the strike of the vein and it is said that enough ore is exposed to justify the construction of a 200-ton mill. The Silver Horn company employs 25 men. Three other companies are working on a smaller scale.

NEW MEXICO

Carpenter.—The Strom Development Co., recently organized by El Paso business men, is planning development of the Strom group of claims and the re-opening of the old Chino mine a few miles south of Kingston in Sierra county.

Silver City.—Final payment has been made on the purchase of the Cora Miller mine about 16 miles west of Tyrone, by the Montclair Mining Co., who purchased it in February 1920 and immediately started construction of a 30-ton cyanide plant which was placed in operation in December. The mill is equipped with jaw-crusher, Hardinge ball-mill, Dorr classifier, Dorr agitators and settlers, American filters, and is driven by Western gas-engines. Recent development on the lower levels of the mine has disclosed milling ore of good grade.

Tyrone.—The Phelps Dodge Corporation's Burro Mountain plant at Tyrone will be shut-down completely on April 1 and will remain down for an indefinite period. The power-plant, containing the largest single installation of Diesel engines in the United States, will be shut-down and the mine allowed to flood. All track and perishable equipment on the lower levels is being taken out and preparations are being made to pull the pumps from the 600-ft. level. The 800 employees will be laid-off, and the hospital, concentrator, and store closed. Gasoline engines are to be installed at the wells to furnish the town with water, as it is expected that a great many of the families will remain in town. Tyrone is one of the most beautiful and picturesque mining towns in the United States and supported a population of over 4000, the majority of whom were Mexicans, as the mines were operated by Mexican labor. There is small hope that the mine will re-open until the low ebb of the copper market is definitely passed.

UTAH

Bingham.—At a meeting of the stockholders of the Silver Shield Mining & Milling Co. on March 24, it was decided to accept the offer to transfer the company to the Bingham Galena Mining Co. on the basis of share for share. The Bingham Galena will assume the debts of the Silver Shield up to a maximum of \$17,000. The Bingham Galena has been developing its own property through Silver Shield workings.

Eureka.—The Mammoth Mining Co. has suspended operations. For some time past, the company has been shipping its ore to the A. S. & R. smelter, but recently the smelting company advised that it could accept but 100 tons per month. As there would be no profit in such a small production, the management of the Mammoth decided to suspend. At the Eureka Bullion property, work of re-timbering the main shaft is in progress, and when completed, prospecting will be undertaken on the 1150-ft. level. One shift has been employed at the property, and the drift on the 1150-ft. level has been going ahead at the rate of five feet per day.

Mines of the Tintic district increased production during the week ending March 25 to a total of 174 carloads of ore, as compared with an output of 155 cars for the previous week. Mines and the number of carloads produced are as follows: Tintic Standard, 68 carloads; Chief Consolidated, 35; Dragon, 18; Iron King, 17; Iron Blossom, 11; Victoria, 5; Eagle and Blue Bell, 4; Swansea, 3; Grand Central, 3; Mammoth, 2; Colorado, 2; Bullion Beck, 2; Eureka Hill, 1; Centennial-Eureka, 1; Gemini, 1; Alaska, 1; total, 174.

Gold Hill.—At the Western Utah Copper mine, ore has been opened up on the 700-ft. level which averages from 5 to 6% copper and \$1.60 per ton in gold and silver. This find was made on the deepest level in the mine and is important. Inasmuch as the ore carries an excess of 35% iron, it is a desirable smelting product. S. M. Soupeoff, of Salt Lake City, is consulting engineer for the company. At present 300 tons of ore per day is mined by 30 men.

Ophir.—At a distance of 178 ft. from the portal, six feet of ore has been found in the main working adit of the Ophir Silver Mines Co., according to G. R. LaCoste, general manager. The ore averages 15 oz. silver per ton, while on the hanging-wall side there is a small seam of ore running several hundred ounces in silver per ton.

Park City.—Development at the Park-Utah mine is opening ore of milling-grade. About 40 men are now employed at the property. This company is controlled by the Judge interests, and is situated in a part of the district that is largely virgin territory.

Production of ore by the mines of this district for the week ending March 25, a total of 1639 tons, shows a decrease as compared with the previous week's output of 1864 tons. The figures follow: Judge Allied companies, 597 tons; Silver King Coalition, 492; and Ontario, 550; total 1639.

Salt Lake City.—According to report made by the Utah Copper Co. to the Utah State Board of Equalization, the value of the real estate owned by the company is \$483,732; of machinery, improvements, and supplies, \$10,661,378; and the valuation of the mine proper, \$9,181,741, this figure representing three times the net proceeds for the year 1920, which amounted to \$3,060,580, as compared with \$6,083,256 for 1919. Therefore, the total value of the company's property in Salt Lake county is \$20,327,450, whereas for the year previous it was \$28,496,091. During 1920, the company mined 5,736,600 tons of ore, from which was produced 27,411 oz. of gold, 257,516 oz. of silver, and 101,897,578 lb. of copper, with a total value of \$18,902,924, while total expenses were \$15,842,345.

WASHINGTON

Spokane.—Four or five carloads of pig-iron per week will be coming into Spokane before the summer is over, or in the early fall, if the plans of the Northwest Iron & Steel Co. of Spokane mature. "The company's plant will have an initial capacity of 25 tons per day, and will be enlarged as development proceeds," says Fred M. Williams, president of the company. "There is no iron furnace on the Coast north of California, so it is easy to understand the importance of this enterprise and the opportunity for developing an industry of

importance. The consumption of pig-iron on the Coast is 500 tons per day.

"The important requisite to success in this enterprise is sufficient high-grade iron ore with ample electric power. These are at hand. We have 300 acres of land and a deposit 60 ft. wide that has been traced 4500 ft. The ore averages 63 % iron.

"We will use the electric process, which makes the finest and purest pig-iron. There are two or three sources from which we will be able to secure ample electric power. Charcoal is important in this process and we have an ample supply. Twenty men will be employed shortly. The plant will be at Leadpoint, 10½ miles from Boundary."

ALBERTA

Edmonton.—A bill has been introduced in the Alberta Legislature incorporating the Imperial Pipe Line Co. for the construction of a pipe-line from the Fort Norman oilfield. It came up in committee on March 13 when William McAdams, representing the Imperial Oil Co., explained that the company's estimate of the cost for construction of one 12-in. or two 6-in. pipe-lines was \$40,000,000, and that two years would be required for the work. Some members contended that the line should be made a common carrier but the promoter of the bill strongly objected on the ground that this would lead to indiscriminate drilling and exhaust the field prematurely in addition to greatly increasing the cost. The bill was reported as it stood leaving the question of making the line a common carrier for further consideration.

Reports from Caribou island, in Great Slave lake, state that machinery is installed in the power-plant and stamp-mill of the Aurous Gold Mining Co. and that good gold ore will be milled with the coming of spring. The ore is said to average \$40 per ton. Fuel-oil will be used to generate power.

BRITISH COLUMBIA

Cranbrook.—The Southern Minnesota & Washington Mining Co. is planning to develop the old Lone Pine group on the international boundary line. The vein as opened is ten or twelve feet wide, containing silver, copper, and lead.

Stewart.—R. G. Edwards Leckie has secured an option from W. W. Rush and Arthur Bagg on the Columbia group of claims situated on the middle fork of Glacier creek. Rush will superintend the development work.

Trail.—Ore receipts at the Trail smelter of the Consolidated Mining & Smelting Co., from February 28 to March 8, inclusive, totalled 8107 tons. This brings the aggregate for the year up to 74,318 tons. Among the larger shippers from independent properties were the Bluebell, Riordell, with 193 tons; the Horn Silver, Similkameen, 232; and the Paradise, Windermere, 207.

Victoria.—John Hart, Minister of Finance in the British Columbia government, asserts that arrangements had been made to make allowance to mining companies operating in the Province for mine-depletion in valuing their properties for taxation. For several years this concession has been sought, but the Government has not been able to see its way clear to concede it. It is felt that the attitude of the administration will have an important effect. There is a possibility that the Hedley Gold Mining Co., for instance, might find it possible to re-open the Nickel Plate. This company adopted its present policy of inactivity on the ground that it was foolish to continue taking ore from the property, thus reducing reserves, when no allowance for depletion was made in assessments and while operating costs were high and the purchasing power of gold extremely low. The relief afforded might be just sufficient to turn the scale.

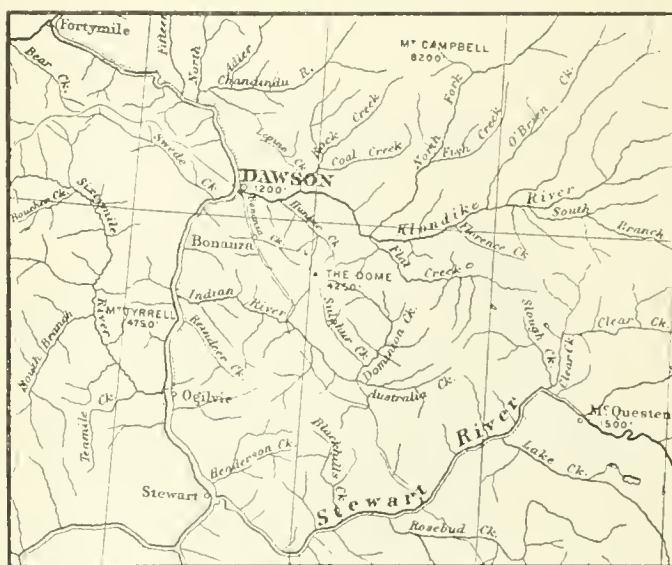
MEXICO

El Tigre.—In spite of the prevailing low price of silver the El Tigre mine is shipping at a profit and operations will not

be discontinued, according to J. D. Cassabaum. On account of the high freight-rates it has been necessary to reduce wages at the mines.

Monterrey.—Rich mines may be developed upon the 2,000,000-acre ranch of the Continental-Mexican Rubber Co. of New York and Torreon, Mexico, as a result of recent discoveries of gold and silver ore upon the property. This hacienda was purchased about 15 years ago by the Continental-Mexican Rubber Co. for the heavy growth of wild guayule that covered most of the land.

Old-time American prospectors are 'flocking' into this country, many of them coming from Arizona, New Mexico, Texas, and other States. For the first time in several years it is safe for the prospectors to travel over the mountain trails and penetrate the more remote localities. The filing upon mining claims is being done at an almost unprecedented rate notwithstanding the fact that the industry is going through a period of depression, due to the low price of



Yukon Territory

metals, unsettled labor conditions, and poor transportation facilities.

In the Guanacevi district, State of Durango, Hilario Lozoya of El Paso, who has extensive mining interests in Mexico, has filed upon claims covering about fifty acres. It is stated that there are veins of gold, silver, and copper ore on the property. Mr. Lozoya will install equipment and machinery and begin the development of the group.

In the Mazapil district, State of Zacatecas, several valuable mines, title to which were forfeited during the revolutionary period, have been filed upon and the new owners are preparing to re-open the properties. One of the forfeited groups was the Aurora mines, which have just been taken over by W. Thomas Moore, a well known American mining man. Mr. Moore will install machinery and make other improvements to the property.

The Mazapil Copper Co. which owns a 500-ton smelter at Concepcion del Oro and a similar plant at Saltillo is showing no signs of decreasing its mining and smelting operations on account of the low price of metals. It is working several mines in the Mazapil district.

According to information that has reached here, the Avino Mines Co., a British corporation which invested several million dollars in mines and the construction of reduction plants in the Avino district, State of Durango, plans to resume operations. The mines and mills of the company have been closed down for several years, but will be rehabilitated.

In the Vetagrande district, State of Zacatecas, Fred Weber will resume the operation of several promising silver mines. The Nuevo Refugio group of mines is to be developed by Manuel Sescosse who recently obtained title to the property. Announcement is made that the two groups of mines owned by the Cartagena Mining Co. are to be sold at public auction.

Pachuca. The recent report of the Santa Gertrudis Co. states that the ore from the El Bordo mine continues to offer difficulty in the thickening and slime-filtering department. Additional equipment is being installed to overcome this condition. The profit from milling 65,513 tons of ore from the Santa Gertrudis mine was estimated at £1369.

ONTARIO

Cobalt. The annual report of the La Rose Consolidated for 1920 shows that the profits were greatly affected by the shortage of power and labor. The production of silver was 410,445 oz. of the net value of \$313,995, as compared with 289,317 oz. of the value of \$356,124 in 1919. Some exceptionally rich ore recently has been found at the University mine.

Kirkland Lake.—The gold mining industry is showing increased activity with the advance of the season, and development at several properties is being resumed. The mill of the Teck-Hughes is again working at capacity treating 125 tons of ore per day. Good results are being obtained at the 350-ft. level. Improvements in the mill looking to an increase in tonnage are planned. The Bidgood is getting in supplies preparatory to undertaking development work, including the sinking of the main shaft from the 300-ft. level to a depth of 500 ft. At the King-Kirkland, comprising a group of claims four miles east of the Tough-Oakes, the shaft is down 60 ft. where the vein shows good gold content. The Lebel-Oro is putting down a shaft with hand-steel and has found ore at a depth of 50 ft. The Kitchener-Kirkland is developing its property in the Goodfish Lake district with a small force, which will shortly be increased. As soon as the weather will permit the Ontario-Kirkland will begin laying the foundation for its mill, the excavation work for which was done last year. The mill, which will have a capacity of about 100 tons per day, will be the sixth mill in the camp. A raise has been started from the 300-ft. level which will form a permanent working shaft. An important ore-shoot has been entered on the 450-ft. level.

Larder Lake.—At a special general meeting held on March 19, the shareholders of the Canadian Associated Goldfields, Ltd., unanimously voted to purchase the assets of Associated Goldfields, Ltd., Harris-Maxwell, Larder Lake Gold Mining Co., Ltd., and Tournie (Old Indian) Mining Co., Ltd. The transaction was also ratified by the shareholders of Associated Goldfields, Ltd. It was stated that on the Harris-Maxwell property high-grade ore had been found.

Sudbury.—The British-America Nickel Corporation will resume operations about April 20. Development work and alterations looking to efficient operation of the Murray mine will be undertaken.

YUKON

Dawson.—Word has been received from Ottawa to the effect that the bill to incorporate the Mayo Valley Railway, Ltd., has passed through the House without revision, although question was raised as to the sufficiency of the capital. The projected line is to be 50 miles long, and will run along the valleys of the Mayo and Stewart rivers. The capitalization of the company is \$750,000, and the estimate of the cost of construction is between \$25,000 and \$30,000 per mile. The object of the railway is to open up the Mayo region, which now gives promise of becoming a permanent silver-lead mining district.

PERSONAL

The Editor invites members of the profession to send particulars of their work and appointments. The information is interesting to our readers.

H. E. Colbran is here from Denver.

M. Araki, chief engineer for the Mitsui company of Japan, was in Utah several days on his way to New York.

H. C. Dudley passed through San Francisco on his return from Arizona to Duluth.

H. J. Browne has moved from Denver to Houghton, Michigan.

Javier Horcasites, of Golden, Colorado, is at Chihuahua, Mexico.

W. H. Seamon Jr., of El Paso, Texas, is at Lakeland, Florida.

Thomas B. Stearns has returned from Honolulu on his way home to Denver.

Fred B. Farish and Roy H. Elliott were at Grass Valley, California, last week.

G. A. Joslin, of Salt Lake City, has gone to Bayhorse, Idaho, for the summer.

W. J. Loring has returned from an inspection of the Silver Hills mine in Nevada.

Clement A. Hack, of Melbourne, passed through San Francisco on his way to London.

John A. Rice has moved his office from 525 Market street to 414 Hobart building, San Francisco.

Frederick G. Clapp, of New York, is delivering a series of lectures to the geological classes at Harvard.

Herbert N. Witt has been appointed geologist to the Consolidated Virginia Mining Co., at Virginia City, Nevada.

C. J. Plnson, superintendent for Cia. Minera de Peñoles, S. A., at Avalos, Zacatecas, Mexico, is at Fullerton, California.

E. W. Engelmann, consulting research engineer of the Jackling porphyry properties, has returned from New York to Salt Lake City.

Morton Webber was in San Francisco recently. He has left for Arizona and expects to return to New York about the middle of April.

D. C. Jackling left San Francisco on March 24 for New York. He visited the Ray Consolidated and Chino Copper properties on his way.

E. E. Smith, of Monterrey, Mexico, is at Salida, Colorado, on account of the closing of the smelters of the Peñoles Company at Monterrey and Torreon.

J. C. Dick, who recently resigned from Government service, has returned to Salt Lake City, where he will open an office as consulting mining engineer.

Thomas D. Harris, manager for the Marysville Dredging Co., at Marigold, California, has gone to Talkeetna, Alaska, where he will be until next October.

Robert Marsh Jr., formerly superintendent of the Ruth mine of the Nevada Consolidated Copper Co., spent several days at Salt Lake City recently. He is now in San Francisco.

F. W. Ridley, superintendent for the Allouez and Centennial Mining companies in Michigan, and F. H. Haller, superintendent for the Osceola Consolidated Mining Co., have been visiting mining districts in Utah.

J. E. Bomberger, president of the Ontario Silver Mining Co. at Park City, has returned to his home at Salt Lake City, after a trip to Chile, where he visited the Chile and Braden copper mines. E. L. Newhouse accompanied Mr. Bomberger to South America.

W. M. Barker has resigned his position with the Nevada Consolidated Copper Co. at McGill, Nevada, to accept appointment as experimental and erecting engineer in the pulverized-coal department (Holbeck systems) of the Bonnot Company, at Canton, Ohio.

THE METAL MARKET



METAL PRICES

San Francisco, March 29

Aluminum-dust, cents per pound.....	75
Antimony, cents per pound.....	7.50
Copper, electrolytic, cents per pound.....	13
Lead, pig, cents per pound.....	4.25-5.25
Platinum, pure, per ounce.....	\$75
Platinum, 10% iridium, per ounce.....	\$105
Quicksilver, per flask of 75 lb.....	\$46
Spelter, cents per pound.....	7.50
Zinc-dust, cents per pound.....	12.50-15.00

EASTERN METAL MARKET

(By wire from New York)

March 28—Copper is of a better tone and higher. Lead is inactive but steady. Zinc is lifeless and unchanged.

SILVER

Below are given official or ticker quotations for silver in the open market as distinguished from the fixed price obtainable for metal produced, smelted, and refined exclusively within the United States. Under the terms of the Pittman Act such silver will be purchased by the United States Mint at \$1 per ounce, subject to certain small charges which vary slightly but amount to approximately three-eighths of one cent. The equivalent of dollar silver (1000 fine) in British currency is 46.65 pence per ounce (925 fine), calculated at the normal rate of exchange.

New York		London	Average week ending		
Date	cents	pence		Cents	Pence
Mch. 22.....	58.75	34 1/2	Feb. 14.....	61.70	33.32
" 23.....	56.87	33 1/2	" 21.....	58.81	34.00
" 24.....	58.75	33 1/2	" 28.....	55.67	32.22
" 25.....	57.25	Holiday	Mch. 7.....	54.18	31.52
" 26.....	57.25	Holiday	" 14.....	55.12	32.04
" 27 Sunday.....			" 21.....	56.69	33.00
" 28.....	57.25	Holiday	" 28.....	57.69	33.45
Monthly averages					
	1919	1920		1919	1920
Jan.	101.12	132.77	July	106.36	92.04
Feb.	101.12	131.27	Aug.	111.35	96.23
Mch.	101.12	125.70	Sept.	113.92	93.66
Apr.	101.12	119.56	Oct.	119.10	83.48
May	107.23	102.69	Nov.	127.57	77.73
June	110.50	90.84	Dec.	131.92	64.78

COPPER

Prices of electrolytic, in cents per pound.

Average week ending			Average week ending		
Date					
Mch.	22.....	12.00	Feb.	14.....	13.00
"	23.....	12.00	"	21.....	12.83
"	24.....	12.12	"	28.....	12.67
"	25.....	12.25	Mch.	7.....	12.43
"	26.....	12.25	"	14.....	12.16
"	27 Sunday.....		"	21.....	11.87
"	28.....	12.25	"	28.....	12.15
Monthly averages					
	1919	1920	1921	1919	1920
Jan.	20.43	19.25	12.94	20.82	19.00
Feb.	17.34	19.05	12.84	22.51	19.00
Mch.	15.05	18.49	.....	22.10	18.75
Apr.	15.23	19.23	.....	21.66	16.53
May	15.91	19.05	.....	20.45	14.03
June	17.53	19.00	.....	18.55	13.18
July	.....	.....	.....	.....	.....
Aug.	.....	.....	.....	.....	.....
Sept.	.....	.....	.....	.....	.....
Oct.	.....	.....	.....	.....	.....
Nov.	.....	.....	.....	.....	.....
Dec.	.....	.....	.....	.....	.....

LEAD

Lead is quoted in cents per pound, New York delivery.

Lead is quoted in cents per pound				Average week ending			
Date				Feb.	14		4.71
Mch.	22		4.00	"	21		4.52
"	23		4.00	"	28		4.12
"	24		4.00	Mch.	7		4.06
"	25		4.00	"	14		4.04
"	26		4.00	"	21		4.00
"	27 Sunday			"	28		4.00
"	28		4.00				
Monthly averages							
	1919	1920	1921		1919	1920	1921
Jan.	5.60	8.65	4.96	July	5.53	8.63	.....
Feb.	5.13	8.88	4.54	Aug.	5.78	9.03	.....
Mch.	5.24	9.22	.....	Sept.	6.02	8.08	.....
Apr.	5.05	8.78	.....	Oct.	6.40	7.28	.....
May	5.04	8.55	.....	Nov.	6.76	6.37	.....
June	5.32	8.43	.....	Dec.	7.12	4.76	.....

TIN

Prices in New York, in cents per pound.

Prices in New York, in cents		Monthly averages				
	1919	1920	1921	1910	1920	1921
Jan.	71.50	62.74	35.94	July	70.11	49.29
Feb.	72.44	59.87	32.16	Aug.	62.20	47.60
Mch.	72.50	61.92	...	Sept.	55.79	44.43
Apr.	72.50	62.17	...	Oct.	54.82	40.47
May	72.50	54.99	...	Nov.	54.17	36.97
June	71.83	48.33	...	Dec.	54.94	34.12

ZINC

Zinc is quoted as spelter, standard Western brands, New York delivery, in cents per pound.

Date	Average week ending		
Mch. 22.....	5.20	Feb. 14.....	5.41
" 23.....	5.20	" 21.....	5.35
" 24.....	5.20	" 28.....	5.20
" 25.....	5.20	Mch. 7.....	5.10
" 26.....	5.20	" 14.....	5.25
" 27 Sunday.....		" 21.....	5.25
" 28.....	5.20	" 28.....	5.20

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, according to quantity. Prices, in dollars per flask of 75 pounds.

Date	1919	1920	1921
Feb. 28.....	47.50	47.50	45.00
Mch. 8.....	47.50	47.50	46.00
Monthly averages			
Jan.	103.75	89.00	50.00
Feb.	90.00	81.00	48.75
Mch.	72.80	87.00	...
Apr.	73.12	100.00	...
May	84.80	87.00	...
June	94.40	85.00	...
Monthly averages			
July	100.00	88.00	...
Aug.	103.00	85.00	...
Sept.	102.60	75.00	...
Oct.	86.00	71.00	...
Nov.	78.00	56.00	...
Dec.	95.00	52.50	...

SECRETARY WEEKS ON TARIFF AND TAXES

John W. Weeks, the new Secretary of War is quoted as follows: Before the War we got about one-half of our revenue, outside of the post-office receipts, from the tariff, and about one-half from internal revenue. That was before the 'demon rum' had gone on vacation and into solitary confinement for all time. But these two sources of revenue were not sufficient to carry even the smallest operations of the War, so the Government acted as other countries had already done, particularly Great Britain, and imposed an excess-profits tax.

You cannot collect an excess-profits tax when people are losing money, and, therefore, as soon as the War was over the excess-profits tax should either have been repealed or greatly modified. The surtaxes of the income tax are too high. The taxpayer has been investing his money in non-taxable securities. There are many instances of the richest men in the United States who do not pay to the Government a single dollar in taxes. Now, they would pay these taxes if the surtaxes were reasonable.

The rates of duties on importations coming into this country average less than 6%. Twenty years ago they were as high as 23%. The situation is aggravated by the condition of exchange. Instead of getting the duty which would be paid under the normal rate of exchange we are getting the duty on the depreciated rate of exchange, which brings us down to about 5.75% average duty. A provision should be made in the law permitting the Secretary of the Treasury to change the rate of duty when there is any material modification of the rate of exchange.

The German who was receiving five marks before the War, or \$1.20 in our money, is now receiving from 50 to 75 marks, which is less than \$1.20 in our money. He is getting less in our money today than before the War, while our workmen of the same class have more than doubled their rates of pay. Even with the reduction of 20% in wages by the mills in Massachusetts, which has recently gone into effect, the wages are now 209% more than they were at the beginning of the War.

That means we cannot compete with German labor under those conditions, and if we made a rate of duty which would protect us against German goods, Great Britain could not ship a dollar's worth of goods into this country. The rate of duty would be overwhelming and that must be taken into consideration. And then we must look after our own markets. We not only want to buy, but we want to sell, and we must place the rate of duty on importations into this country as reasonably as possible to enable these people on the other side to get on their feet. You cannot sell goods to a pauper. You can only sell them to those who have the means with which to pay, and there are only two ways to pay for goods which you import—one is with gold and the other is with goods that you ship to them. Therefore, when we consider a tariff duty in this country, we have got to consider those people over there, and help them to get on their feet, at the same time that we are helping ourselves.

It is a complicated question. It will be solved in some way. Based on \$4,000,000,000 a year, which we are told we have got to raise, I think that imports should pay about \$750,000,000 of that, and that would be done, practically speaking, if the duties were now assessed on normal rates of exchange.

MONEY AND EXCHANGE

Foreign quotations on March 29 are as follows:

Sterling, dollars:	Cable	3.92 1/2
	Demand	3.93 1/2
Francs, cents:	Cable	7.05
	Demand	7.07
Lire, cents:	Demand	4 1/4
Markes, cents:		1.63

Eastern Metal Market

New York, March 23

There is no improvement in demand for any of the metals and the markets are all lifeless and devoid of interest. Prices are fairly stationary at levels below pre-war values or nearly so, but even this does not stimulate interest.

Almost no demand features the copper market, but prices are stationary.

Buying of tin is small and confined to transactions between dealers.

Demand for lead and zinc is at a low ebb, with prices unchanged at the low levels of a week ago.

IRON AND STEEL

Better buying for steel for construction and the reinstating of a few of the voluminous cancellations by automobile builders have been favorable features of the week, says 'The Iron Age'. A good many buyers have been heard from with small orders, without any increase in the average of steel-plant activities. Little is said of the spring demand of which there were predictions when the year came in, and there is more settling down to the prospect of a drifting market.

Price developments are not uniform and cannot be called significant. Pig-iron and scrap are lower, particularly the latter. In finished lines the weak spots still are wire products, sheets, and bolts and nuts. As heretofore, plates, shapes, and bars have been available at 2c., Pittsburgh, but there are also some instances of the withdrawal of that price. The sharp advance in costs due to restricted operations has more than offset with some steel producers the help of recent reductions in wages.

The Steel Corporation has been taking new business at the rate of about 15,000 tons per day, or nearly one-third of capacity. The flow of specifications in some lines has slowed down under independent offerings at lower prices, but the effect has not been marked.

More blast-furnaces are going out, and the Steel Corporation's curtailment of pig-iron output has been rather rapid. Its steel production has not declined in proportion, in view of the stocks of pig-iron and scrap it has on hand.

On all sides the effort is being made to reduce to the minimum the output of pig-iron at present high costs. Out of 166 merchant furnaces only 27 are now operating, including two in Alabama and one in Tennessee, and several furnaces in New York, Pennsylvania, and Ohio will probably blow-out soon.

The week has been the best in many months in structural steel, with a total output of 17,000 tons, which compares with 25,000 tons for all of February.

COPPER

Demand for copper is confined to small lots here and there, which is being satisfied by one or two interests at lower prices than some of the other producers or sellers are willing to entertain. The low values referred to are 12c., delivered, or 11.87½c., New York, for electrolytic copper for early delivery with up to 12.25 to 12.50c. asked for future shipment or to the end of the first half. Large producers have still higher prices as a minimum; in fact, quotations vary according to the seller, with actual buying done at the low levels. Lake copper is inactive at 12.25c., delivered, from small sellers with higher prices asked by large producers. The latter part of last week there was a somewhat better inquiry, which imparted a better tone to the market temporarily, but this has subsided. In some reports it is said that 12c. copper has disappeared, but today it can be bought in limited quantities at that price.

TIN

Interest in the market is light and the little business being

done is confined to transactions between dealers. While business of this character was fairly brisk a week ago it has lessened, though a little has been done each day. In general, however, there are few sellers. The market is decidedly quiet in every department. Prices for spot Straits have hovered around 28 to 28.50c., New York, with the quotation yesterday at the latter figure as compared with 28c. a week ago. A feature, if it may be so designated, is the scarcity of 99% tin, of which there have been fair sales recently, enough to clear up the market pretty generally. London prices have been for the most part steady, quotations yesterday having been £157 per ton for spot standard, £160 10s. for future standard, and £163 for spot Straits. These prices are close to those ruling a week ago. Arrivals thus far this month have been 1483 tons. The quantity afloat, the smallest in many months, is 400 tons.

LEAD

This market is even more quiet than a week ago, but prices are steady and unchanged. The leading interest continues to ask 4c., both New York and St. Louis, and is apparently taking such business as is offered. Asking prices by the independents, if they quote, are not as high as a week or two ago, being now around 4.25c., New York, or under, the tendency being slightly downward. In general there is hardly any business and the market is lifeless and without feature.

ZINC

The general inactivity could hardly be more pronounced. One seller states that inquiries the past week have been fewer than at any time since the close of the War. Buying is confined to small lots for hand-to-mouth needs and there is little of this. Prices are almost nominal at 4.70c., St. Louis, or 5.20c., New York, for prime Western for early delivery. It is estimated that actual output is around 30% of normal for the five years before the War.

ANTIMONY

The asking price of most sellers is 5.37½ to 5.50c., New York, duty paid, but a firm offer would be accepted at 5.25c. it is generally admitted. The market is very quiet.

ALUMINUM

Virgin metal, 98 to 99% pure, in wholesale lots for early delivery, is quoted at 28c., f. o. b. plant, by the leading producer, with other sellers asking 23 to 23.50c., New York, for the same grade.

ORES

Tungsten: Conditions are unchanged and quotations are nominal. Prices range from \$2.60 per unit, upward, depending on the grade.

Ferro-tungsten is quoted at 58c. per pound of contained tungsten in the lump and guaranteed form.

Molybdenum: Quotations are nominal at around 50c. per pound of MoS₂ in regular concentrate in the absence of any interest from consumers.

Manganese: There is no demand for foreign high-grade ore, which is quoted nominal at 30 to 35c. per unit, seaboard.

Manganese-Iron Alloys: The market for ferro-manganese and spiegeleisen is exceedingly quiet, quotations remaining nominally unchanged. For British ferro-manganese the asking price is \$100, seaboard, and for the American it is \$95 to \$100, delivered; both could undoubtedly be shaded down to an equivalent of \$90, delivered. Spiegeleisen is quoted nominally at \$32.50 to \$35, furnace. Inquiries for both products are confined to carload lots.

Current Prices of Commodities

The figures given on this page represent the regular current price, at the time of our going to press, to industrial buyers of standard commodities in small wholesale lots on San Francisco Bay. They should not be construed as being quotations nor as being either the lowest or the highest price; they are given rather as a guide by which to follow the trend of the market or to estimate the approximate cost of materials and supplies.

CHEMICALS AND ASSAYERS SUPPLIES

Acid, sulphuric, com'l 66%, in drums, per 100 lb.	1.50 to 2.00
" " " " carboys, " " " "	2.60 to 3.10
" " " C. P., 9-lb. bottles, in barrels, per pound.	0.27
" " " C. P., bulk, in carboys, per pound.	0.22
" muriatic, com'l, in carboys, per 100 lb.	2.75 to 3.25
" " " C. P., 6-lb. bottle, in barrels, per pound.	0.32
" " " C. P., bulk, in carboys, per pound.	0.25
" nitric, com'l, in carboys, per 100 lb.	9.00 to 9.50
" " " C. P., 7-lb. bottles, in barrels, per pound.	0.39
" " " C. P., bulk, in carboys, per pound.	0.32
Argols, ground, in barrels, per pound.	0.15
Borax, cryst. and conc., bags, per 100 lb.	6.00 to 6.90
" powdered, in barrels, per 100 lb.	6.50 to 7.35
" glass, ground, 30 mesh, cases, tin lined, per 100 lb.	21.00
Bone ash, 60 to 80 mesh, in barrels, per 100 lb.	8.50
Bromine, 1-lb. bottle, per pound, Merck.	2.00
Cyanide, sodium, 96 to 98%, 100-lb. drums, per pound.	0.34
Lead acetate, brown, broken casks, per 100 lb.	18.50
" " white, broken casks, per 100 lb.	19.00
" " " crystals, per pound.	0.20
" " " C. P., test., granulated, per 100 lb.	17.50
" " " C. P., sheet, per 100 lb.	14.50
Litharge, C. P., silver-free, per 100 lb.	15.50
" com'l, per 100 lb.	12.50
Manganese oxide, bulk, imported in barrels, per ton.	90.00
Manganese di-oxide, bulk, Caucasian (85% MnO ₂ , - 15% Fe) in casks, per ton.	140.00
Potassium nitrate, double ref'd, small cryst., in barrels, per pound.	0.18 1/2
" " " " granular, " " " "	0.18 1/2
" " " " powdered, " " " "	0.19
" carbonate, calcined, per 100 lb.	0.25
" permanganate, in drums, per pound.	0.70
Silica, powdered, in bags, per pound.	0.03
Soda, carbonate of (ash), in barrels, per 100 lb.	3.50
" bicarbonate of " " " "	4.00
" caustic, ground, 98% " " " "	6.50
" solid, " " " "	5.00

ELECTRICAL SUPPLIES

Armored copper cable, size 8, BXL 3, lead and armor, 100-ft. lots, per 1000 ft.	700.00
Armored copper cable, size 8, BX 3, armor, 100-ft. lots, per 1000 ft.	393.00
Conduit, galvanized iron, 3/4-in., per 100 ft.	13.50
" " " 2-in., " " " "	43.50
Copper wire, size 0, bare, 200 to 1000-lb. lots, per 100 lb.	19.45
" " " 10, triple-braid, weather-proof, coil lots, per 100 lb.	24.50
" " " 14, single-braid, rubber-covered, " per 1000 lb.	9.40
Insulators, glass for telephone, No. 9 pony, per 1000.	95.00
" " " power, No. 14, per 1000.	113.00
" " porcelain, 6600 v. No. 44, per 100.	21.50
Porcelain knobs, No. 5 1/2, 10d. 'nailit', per 1000.	36.00
" " " " solid, per 1000.	20.50
" " " 3 1/2, " " " "	74.80
" tubes, 5/16 by 3-in., per 1000.	12.80
" " 1/2 8-in., " " " "	48.95
Sockets, weather-proof, molded, No. 60,666, per 100.	31.20
Telephone wire, iron, size 12, half-mile lots, per 100 lb.	11.25

EXPLOSIVES

Blasting-caps, No. 6, in lots of 5000, per 1000.	18.80
" " electric, 6-ft., No. 6, in lots of 1000, per box of 100.	9.30
Blasting-powder, "B" soda, in 100-kg lots, per keg of 25 lb.	2.20
Dynamite, nitro-glycerine, 40%, in ton lots, per 100 lb.	20.50
" gelatine " " " "	21.50
" ammonia " " " "	19.50
Fuse, common, in case lots, per 1000 ft.	8.50
" waterproof, triple tape, in case lots, per 1000 ft.	10.54

FUELS

Coal, Utah steam, \$4 at mine, plus \$7.50 freight to California terminal points, in carload lots, per ton.	11.50
Coal, blacksmith's, in carload lots, per ton.	25.00
" " " in small lots, per ton.	29.00
Coke, in carload lots, per ton.	27.00
Fuel oil, per barrel.	2.00
Diesel oil, per gallon.	0.07
Distillate " " "	0.16 1/2
Gasoline " " "	0.26 1/2

HARDWARE

Anti-friction metal, per pound.	0.28 1/2
Nabbitt, genuine " " "	0.64
Brass sheets, half-hard and soft, per pound.	0.30
Drill-steel, hollow, first grade, in ton lots, per pound.	0.20
" solid " " " "	0.12

Fish-plate bolts, 7/8 by 2-in., per 100 lb.	10.40
Nails and spikes (20d to 60d base), per keg.	5.50
Nuts, hot pressed, hexagonal, per 100 lb.	13.00
" cold punched " " " "	14.00
Picks, mining, 5-lb., per dozen.	12.00
Shovels, carbon steel, No. 2, long handles, per dozen.	19.75
Track spikes, per 100 lb.	7.15

HEAVY STEEL AND PIPE

Bar steel, soft, per 100 lb.	4.75
Rails, steel, 8 to 25-lb., per 100 lb.	5.55
Reinforcing-steel, per 100 lb.	5.25
Sheets, corrugated, galvanized iron, 26-gauge, per 100 lb.	8.55
" flat " " " "	8.45
" corrugated, black iron, " " "	5.25
Structural T's, channels, angles, and beams	5.00
A deduction of 15c. per 100 lb. is made on the above when purchased in carload lots.	
Bars, steel, square, cold-rolled, per 100 lb.	8.00
Pipe, wrought-iron, black, standard, 1 1/2-in., per 100 ft.	16.30
" " galvanized " " " "	19.90
" " black " 4-in. " "	70.65
" " " extra strong " " "	127.50
Shafting, cold-rolled (2 1/2 to 3-in. base) " " "	6.75

HOISTING-ROPE

Discounts for delivery from Pacific Coast stocks are: cast-steel, 12 1/2%; extra strong cast-steel, 20%; plow-steel, 25%; blue-centre steel, 10%. The following illustrations indicate the net price for each kind of rope, in standard, 6-strand, 19-wire, 1-in. rope.

Blue-centre rope, per foot.	0.45
Cast-steel rope, per foot.	0.27
" " extra strong, per foot.	0.30
Plow-steel rope, per foot.	0.33

LUMBER

The figures given are subject to variation, depending upon the size and length. A charge for cartage is also to be added. Prices are furnished by Van Arsdale, Harris Co.

Fir, No. 2 clear and better, 1 to 2 in. thick, up to 16 in. wide, per thousand feet (M).	90.00
Fir, common, base price, per M.	30.00
Fir, common, 6 by 6-in. up to 12 by 12-in., per M.	36.00
Redwood, rough merchantable, 1 to 4 in. thick, per M.	50.00
" clear, 1 to 2 in. thick, up to 12 in. wide, per M.	100.00
Spruce, 'B' and better, 1 to 2 in. thick, up to 16 in. wide, per M.	90.00
Sugar-pine, No. 1 and 2 clear, 2 in. thick, up to 16 in. wide, per M.	200.00
White cedar " " " "	180.00
White pine " " " "	180.00

MISCELLANEOUS

Air-hose, 1-in., 5-ply, plain, per foot.	0.48 to 0.65
Candles, 'Granite' mining, 6-16-40, 10-case lots, per case.	5.00
Carbide, in 100-lb. cans, per can.	7.75
Cotton waste, best grade, per 100 lb.	21.50
Diamonds for drilling, according to size, per carat.	50.00 to 75.00
Manila rope, grade 1, per pound.	0.19
" " " 2 (standard), per pound.	0.18
Packing, flax, per pound.	0.50 to 1.00
" sheet " " " "	0.35 to 1.00
" steam or water, first grade, per pound.	1.05
Silex lining, crated, per long ton.	35.00
Tube-mill pebbles, Danish, selected (in bags), per long ton.	30.00

PORTLAND CEMENT, LIME, ETC.

Fire-brick, clay, per 1000.	60.70
Fire-clay, in bags, per ton.	18.00
Lime, lump, in barrels, per barrel.	3.25
Portland cement, in bags, per barrel of 400 lb.	4.20
Allowance of 15c. for bags returned in good condition.	
Portland cement, in barrels, per barrel.	5.50
A deduction of 50c. per barrel is made on lime and cement when sold in carload lots.	

ORES AND MINERALS

The following prices represent approximately what can be obtained for the products indicated delivered at points on San Francisco Bay. These, of course, vary widely with the grade and purity of the ores. The present stagnant condition of the market makes many of the quotations purely nominal; most of the ores can be purchased at these prices, but it should be understood that it is not easy for the producer to market them at this time. This list is corrected monthly by Atkins, Kroll & Co.

Antimony ore, approximately free of lead and arsenic, not less than 50% Sb, per %.	60c.
Asbestos (crystalline), according to length of fibre, per ton.	\$20 to \$2500
Barite, white and free of iron (crude), per ton.	5 to 10
Bismuth ore, not less than 20% Bi, per % Bi.	12
Feldspar, crude, lump, free of iron, per ton.	5 to 10
Fluorspar, 85% calcium fluoride, per ton.	15 to 20
Fuller's earth ground to pass 80-mesh, per ton.	5 to 10
Graphite, crystalline, per pound.	3c. to 7c.
Magnesite, calcined, per ton.	25 to 35
Manganese ore, less than 0.75% Fe; less than 0% SiO ₂ , per ton.	25 to 30
Mica, according to size, cleanness, and cleavage, per pound.	1 to 8
Molybdenite, not less than 85% free of copper, per % MoS ₂ .	8 to 12
Ochre, according to strength, crude, per ton.	8 to 15
Sulphur, 99.5% pure, only trace of As and Se, per ton.	15 to 18
Talc, lump, white, per ton.	7.50 to 10
Tin ore, not less than 60% Sn, per % Sn.	5
Tungsten ore, not less than 65% WO ₃ , per % WO ₃ .	2.60

Company Reports

ORIENTAL CONSOLIDATED MINING COMPANY

Report for the year ended June 30, 1920

Property: Mines and mills in Unsan district, Korea

Operating Officials: Alf Welhaven, general manager; Thomas W. Van Ess, assistant general manager, H. A. Cobb, superintendent, Taracol, Chintul, and Tingkol

Financial Statement: Receipts, \$1,188,629.39; total operating costs, \$856,967.00; reserves for depreciation, \$306,610.08; net profit, \$25,052.305.

Dividends: July 1919, \$107,347.50; March 1920, \$214,695.

Development: 25,521 ft.; 1869 ft. less than previous year. Reserves at Tabowle mine averaged 384,000 tons at \$5.43, as compared with 441,000 tons at \$5.44 on July 1, 1919; at Taracol mine, 345,000 tons at \$4.60, as compared with 260,000 tons at \$4.54; at Chintul mine, 32,500 tons at \$4.33, as compared with 32,500 tons at \$4.33; at Tongkol mine, 6250 tons at \$9.67, as compared with 5500 tons at \$10.18.

Production: 233,323 tons of ore was milled containing gold valued at \$1,357,036.47, 89.9% of which was saved in the form of amalgamation bullion and concentrate. The cyanide plant treated 23,763 tons of concentrate containing gold valued at \$651,378.39, and saved \$6.4% of this.

Operating Conditions: The salient features of the year's work are:

1. The drought in northern Korea during the summer and autumn of 1919 and the spring of 1920 caused a heavy advance in the cost of foodstuffs, which in turn increased wages and the cost of transportation. The labor situation became more difficult than ever, as efficiency dropped and is now considerably below the standard of three years ago. The natives are restless and unsettled. Chinese laborers have not returned, owing to the adverse exchange.

2. The lack of water for hydro-electric power generation compelled the company to operate by steam power the major part of the year, whereby expenses were greatly increased and profits correspondingly reduced, and all the underground work was retarded and rendered difficult. The Suribong power development scheme was completed, at a total cost of \$549,104.05, of which \$155,680.455 was expended during the year. The Suribong power plant is now running successfully, but during the year just ended the rainfall was so scant that the hydro-electric plants ran at only about one-third capacity.

3. The company has been unable to take advantage of the high premium on gold in China, because the Japanese government prohibits the export of gold.

4. There has been no reduction, on the whole, in the cost of supplies; and deliveries are slow and uncertain. Locally obtainable supplies, such as timber, lumber, cordwood, charcoal, and coke cost more than ever, and there is no reason to expect they will become cheaper in the near future.

EL ORO MINING & RAILWAY COMPANY, LTD.

Report for the year ended June 30, 1920.

Property: Mines, mills, and railroad at El Oro, Mexico.

Operating Officials: A. F. Main, general manager; F. Jenkin, assistant manager.

Financial Situation: The net profit for the year amounted to £62,946 15s. 6d.

Dividends: A dividend of 5%, or 1s. per share, was paid on November 18, 1920.

Development: 329,182 tons of ore was developed. The ore-reserves stand at 293,779 tons, as compared with 333,135 tons at June 30, 1919.

Production: 336,730 tons of ore was treated, of a gross value of \$8.77, producing bullion which realized \$2,789,-

347.27. Working costs show a reduction of 10 centavos per ton treated.

The company is investing its surplus funds in other mining properties in Mexico. Options have been secured on favorable terms on two mines, one with a well-established record of past production, and the other of more recent discovery. Other important enterprises are now the subject of negotiation.

DE BEERS CONSOLIDATED MINES, LIMITED

Annual report for the year ended June 30, 1920.

Property: Mines and washing-plants at Kimberley, Griqualand West, South Africa; explosive works at Somerset West, Cape Colony.

Operating Officials: A. F. Williams, general manager; L. R. Grimmer, J. Harbottle, and R. S. G. Stokes, assistant general managers.

Financial: Receipts from sales of diamonds, £6,761,840 0s.10d.; total revenue, £7,889,929 4s.7d.; mining expenditure, £1,991,258 11s.; balance, £5,153,695 7s.2d.

Dividends: £3,740,000.

General: The expenditure to June 30, 1920, in respect to pay allowed to employees on active service since the commencement of the War amounted to £488,765 3s.; total casualties amount to 101 killed and died, 145 wounded and prisoners of war.

SUPERIOR & BOSTON COPPER COMPANY

Report for year ended September 30, 1920.

Property: Gila county, Arizona.

Operating Officials: E. G. Deane, general manager; C. W. Botsford, geologist.

Financial Statement: Receipts, \$311,604.04; disbursements, \$395,084.64; assets, \$4,693,037.40; liabilities, \$4,643,495.91; to profit and loss, \$49,541.49.

Development: 8397 ft., as compared with 4589 ft. in 1919.

Production: 9104 tons of ore, assaying 5.84% copper and 14.31 oz. silver, for which, after deducting smelting charges and freight, \$212,003.43 was received.

ST. JOSEPH LEAD COMPANY

Report for the year ended December 31, 1920.

Property: Mines and plants in south-eastern Missouri.

Operating Officials: C. J. Adams, general manager; L. A. Delano, mill superintendent; W. A. Smith, manager; E. C. Hickman, assistant manager, Hereulaneum plant.

Financial Statement: Earnings for the year, after allowances for depreciation, depletion, and reserve for Federal taxes, were \$2,563,690.30. The company's surplus was less by \$1,656,389.68 than on December 31, 1919.

Dividends: \$2,889,436.50.

Production: Mines produced 2,133,327 tons of ore; mills, 119,429 tons of concentrate; and smelter, 78,497 tons of pig-lead.

LAKE SHORE MINES, LIMITED

Report for the year ended November 30, 1920.

Property: Mines and works at Kirkland Lake, Ontario, Canada.

Operating Official: R. C. Coffey, mine manager.

Financial: Income, \$528,028.38; net profit, carried forward, \$104,992.59.

Development: 1130 ft., with a production of 19,326 tons of ore.

Production: 18,889 tons was milled for a yield valued at \$483,701.93.

General: Owing to the adverse conditions prevailing, the development work carried out was limited. All ore treated had been developed since the commencement of milling operations.

Book Reviews

This World of Ours. By J. H. Curle. 313 pp. Published by the George H. Doran Company, of New York. For sale by 'Mining and Scientific Press'. Price, \$2.50.

In the first paragraph the author states how, while yet a boy, he resolved to see the world. He made money out of mining and fulfilled his purpose, traveling up and down, from end to end of the world like a Wandering Jew. A bed-ridden man in Australia, reading 'The Shadow Show', expressed the wish that Mr. Curle might write another book. We hope the invalid received a copy of 'This World of Ours' before he died, for it would while away the weary hours. Travel was in his bones, says the author. On his mother's side he claims to be descended from a Pinzon, of Spain, who sailed with Columbus to the discovery of America. That may account for his wanderlust, or perhaps it was only the overstrung nerves to which he refers as the cause of his first voyage to Australia. In any event, he has traveled enormously, at first for his health, then as a valuer of mines, lastly to satisfy a whim, to sate curiosity, to quiet unrest. He tells us how he started to work in a South African mine, acquired experience, applied it to advantage, and made enough money to give him independence; for he did not marry. He made a vow to see every gold mine of any importance in the world; he examined more than 500 in 38 countries; and he was not yet forty years old; so he decided to forego the making of more money, and to travel instead. He was an agnostic; he worshipped Nature; he marveled at Life and Energy; he felt the beauty and the horror of the World. What he feels he records in this book; the beauty and the horror of the world are here described, higgledy-piggledy, without any serious attempt at literary art. The style is the one recommended by Bouffon, namely, the man himself. To those who know Mr. Curle, or who have read 'The Shadow Show', the lack of artifice, the absence of convention, the plain bluntness will be recognized as characteristic. In the days when he wrote on mines, or on mining companies and their vagaries, whether as Special Commissioner to the 'London Economist' or as an occasional contributor to the 'Mining and Scientific Press', he won a reputation as an honest and fearless critic. He said what he thought, and it was interesting, as well as useful, because it was the expression of a keenly observant and thoroughly independent individual. For similar reasons this book of world-travel holds the attention of the reader; he finds himself with one who thinks aloud; who jots down his thoughts as they come, caring but little whether they be pleasing or displeasing, fine or foolish. I read a stupid review of this book in a New York paper, in which some of the few poor passages in the volume were quoted with approval by the reviewer, who wrote a lot of twaddle intended to be sensational. For instance, he quoted the beginning of Chapter IV, where Mr. Curle speaks of the early days of the Rand, Western Australia, Cripple Creek, and the Yukon as "the Elizabethan age of gold mining". An intelligent proof-reader might have saved him from that blunder. Of course, the spacious times of mining adventure were forty years earlier, when the discoveries in California and Australia started a world-wide migration. "The Elizabethan Age began with the discovery of the Rand in 1886," says Mr. Curle. No; it began with the discovery by Marshall at Sutter's mill in 1848 and the finding of gold by Hargraves at Lewis Ponds in 1851. The five years after '49 marked the golden age of mining romance.

Mr. Curle has his own notions about women, as he indicated in 'The Shadow Show', and they are not nice. In the present book he has some bathos about American women. For example: "Today, in America, men proclaim they are weak; not to be leaned on, not looked up to. They proclaim

it—God help them!—with unction; and straightway the minds of women begin to sour, their hearts to atrophy." Mr. Curle gives solemn advice to his fellow males: "Don't be humble to women". He puts it in italic, so that one cannot miss it. Even in Canada he detected "the dreadful spectre of the boss woman". This is Curlesque. Let us mention the blemishes of the book first. He goes to Palestine and visits Jerusalem. This is the poorest chapter in the book, because he has no sentiment for the Holy Land, no historic imagination, no poetic insight; he is a valuer of mines standing on the steps of a temple. "Here was Jerusalem. Up among these rocks was the holy city of Jew and Christian. That the first builders should have perched it on stony ground, among hills so utterly barren, occasioned in me a deep surprise. The station lay a mile out. A deep rift lay between it and the high fortress-like walls of the city. Beyond there stood Mount Zion, and at their extremity the moated citadel of King David, where, through the Suffa gate, one passes into the heart of the town." This recalls the story of the Chicago girl who was asked what she thought of Rome; "I can't rightly remember," she replied, "you see, Poppa bought the tickets."

Our author is at home in South Africa, which he understands and loves. He speaks of Kruger and Rhodes thus: "Here they come! A 'veld-kornet' rides at the head with the Transvaal flag and half a dozen armed Boers follow. Then two Cape carts; and in the second, talking with the 'landdrost', a shaggy old man with a long beard, bushy brows, masterful eyes, and sacs beneath them that hang like dewlaps down his cheeks. He wears a markedly Presbyterian frock coat, an impossible tall hat, he spits copiously, his breast is crossed with a sash, he is followed by a hundred Boers on horseback, and is known to all the world for Stephanus Johannes Paulus Kruger, master of the Transvaal these twenty years, utterly fearless, and the greatest personality, save one, in all Africa. . . . Greatest save one! In Adderley street, a thousand miles away, at the top of the street, among the oak trees, in the very shadow of Table Mountain, stands Parliament House. Years ago, as I wandered past, a man had come down the steps, a thickset man in tweeds and a bowler hat—an English gentleman. Crossing the street to the offices of the Chartered Company, he had presently emerged, and entering a Cape cart, drawn by two superb horses, had been driven rapidly away. Save one! And this was he: Premier and dictator, and of the race of giants, his presence gave a glory to all this peninsula. . . . But Rhodes passed, and the arc-light of Africa went out. The brooding spirit was gone from the slopes of the mountain. The King was dead, and lacking his inspiration, men now sank to the old, old level. In a brief spasm, crying 'We will make Africa' they came together in union; but the fine frenzy of it passed, with the years, leaving only the husk, the shell, and the hate."

Here is the description of a night in Nicaragua: "The people of the huts, a telegraphist, a couple of soldiers and their women, were miserably poor and degraded. They went ragged and barefoot. They were anemic from malaria, and quite listless; when not employed, both men and women would cast themselves into hammocks, and lie with closed eyes. At the dusk the rains came on, and mosquitoes began to bite furiously. The people of the huts ate their miserable supper, and by seven o'clock had crept beneath their mosquito nets and lay asleep. I sat alone, listening to the rain, stung to madness, until, at nine o'clock, there was a sound of wheels, and a lantern came swinging out of the forest. The ox-cart had arrived. It carried a big pen; and in the darkness and the rain a transference of pigs took place. This lasted an hour; after which my baggage was hoisted up, the fowls were hung behind, and we started towards eleven o'clock. It was densely dark in the forest. A boy walked ahead of the four oxen swinging a lantern.

I walked hour after hour by his side, clogged with mud, floundering into quagmires, tripped up over and anon by the branches of trees, my arms working like a windmill. With a gradual stopping of the rain, mosquitoes were upon us in thousands; I lashed my face and legs unceasingly, and the sweat poured from me in a stream. As for the cart, with its solid wooden wheels, now it was stuck in the mud, now dashed from side to side; in the pitch darkness it went bumping and creaking, and only by a miracle escaped capsize, while the oxen groaned under the load, the fowls cried out poignantly, and the squealing of the pigs was something appalling. So passed my first night in Nicaragua. Dawn found me a scarecrow, caked with mud and sweat, bitten to death, and full, did I but know it, of the malaria germs; but Chinandega was reached, I sat down to a superb bowl of coffee, and a pineapple, and my troubles vanished with the rising sun. That day, taking the train, I passed by Momotombo, the famous volcano of Nicaragua, and reached Managua."

I have never seen a bull-fight, from choice; but I have never read a more graphic description of one than Mr. Curle's. His wandering life, of course, is full of vivid contrasts; for example, he goes to Frankfort in winter to hear 'Der Fliegende Holländer' at the opera; he is dining at the Frankfurter Hof: "I had hardly sipped a glass of the wonderful wine [it was a vintage bottle of Graacher] when all the melodies of the opera broke loose in my head. This snow! [It was snowing outside.] It was a very proper setting for the Dutchman, storm-tossed on the coast of the Baltic Sea. His haunting cry arose [in Mr. Curle's brain]; my blood ran cold as the overture developed, and there came a crash of the thunder, the rise and fall of the storm. Now I was come to the song of Senta, which she sings in Bergen, and I had last heard in the forests of Ashanti [in West Africa]. There, at the gold mines, had been a gramophone, as we sat sipping our quinine before dinner, so she had sung to us, and fireflies had come out of the forest." The interpolations are mine.

Here is a glimpse of Borneo. "I explored all the country around. Roads had been laid on the soft clay; but for one who walked them, ten traveled by canoe along the waterways. These penetrated the forest everywhere, and ranged from twenty yards wide to channels four or five feet. The merest runnels sufficed for highways, and often upon my walks, thinking no water near, came canoes to me stealing through the undergrowth. The main streams around the town carried a great traffic; each Malay, each Chinaman, went about his business in a canoe; bales of merchandise, loads of fruit and produce, passed up and down in boats; itinerant vendors made the water their stance, and there were moving lights, cries, and the sounds of passing oars far into the night. Bangkok has been called the 'Venice of the East', but the title belongs to Bandjermasin."

He makes many interesting notes on the migration and mixture of races, and in the course of his wanderings finds several curious ethnic islands. Thus in Colombia: "From the town of Manizales, a northern road leads to the State of Antioquia, where the land is higher, rugged, less fertile, and where, surrounded on all sides by a race sunk in climatic lethargy, a more strenuous people have taken to mining and commerce. The Antioqueño is indeed 'sui generis'; he is a mountain Jew, transplanted from the Old World and thriving up here in the New. When Charles V. importuned by his viceroy for immigrants, could spare none out of Spain, he sent to New Granada [the old name of Colombia] fifty families of Tunis Jews; and these, retaining many characteristics, though neither the Jewish faith nor language, have multiplied, and are become, even after dilution of the blood, the soundest community in Colombia. Do they recollect this in the Souks of Tunis? I should imagine not. But a keener than the Tunisian Jew—the Syrian—has

run across the scent. Today, beginning as a peddler, and passing to a land owner, he is spreading over Colombia."

These quotations from the book will have given the reader of this review—if he has stayed with me until now—some idea of the style and charm of Mr. Curle's account of his travels. He has been not only to distant lands, but to remote corners in those lands; he is no Cook's tourist, he breaks his own trail across the world. At the very beginning of the book, he shows a sense of humor by saying: "As I lay in bed once, computing my achievements, a voice cried in the dark—'You miserable Cook's tourist! What do you imagine you've done? Remember the French jeweler, Tavernier, setting out those centuries ago! And Marco Polo, reaching China in the Middle Ages! Think too, with your wagons-lits and your thermos-flask of Thomas Coryat, walking from Jerusalem to Ajmere at a cost of fifty shillings! Go to sleep!' I did." On the last page of the book he exclaims: "I have seen the whole World, and have no notion what it all means . . . I have lost my way." We shall absolve him from his self-accusation of being a Cook's tourist, for he was his own courier, he found his own way, he endangered his life again and again, he went to hundreds of places beyond the ken of any travel bureau; but he is not a traveler like Humboldt, or Sven Hedin, or Young-husband; he makes no special study of any part of the map; he does not try to fill the blank spaces; he goes where he lists to please himself, and then it happens to please him to write about it in his own unaffected style. He sees the things we would see; he remarks the strange aspects we would observe; so we feel as though we had been with him, and that is why the book is so enjoyable.—T. A. R.

Recent Publications

Natural Gas and Natural-Gas Gasoline in 1918. By E. G. Slevers. H:36, U. S. Geological Survey, 1920. 38 pp. From Mineral Resources of the United States, 1918—Part II.

Tenth Annual Report by the Director of the Bureau of Mines to the Secretary of the Interior for the Fiscal Year Ended June 30, 1920. Bureau of Mines, 1920. 149 pp.

A Deposit of Manganese Ore in Wyoming. By Edward L. Jones Jr. Bull. 715-C, U. S. Geological Survey, 1920. Pp. 3. From Contributions to Economic Geology, 1920, Part I.

The Use of Geology on the Western Front. By Alfred H. Brooks. Professional Paper 128-D, U. S. Geological Survey, 1920. Pp. 40, diagrams. From Shorter Contributions to General Geology, 1920.

Some Deposits of Manganese Ore in Colorado. By Edward L. Jones Jr. Bull. 715-D, U. S. Geological Survey, 1920. Pp. 12. From Contributions to Economic Geology, 1920, Part I.

Gold, Silver, Copper, Lead, and Zinc in Nevada in 1918. Mines Report. By V. C. Heikes. I:12, U. S. Geological Survey, 1920. Pp. 48. From Mineral Resources of the United States, 1918, Part I.

Structure in Paleozoic Bituminous Coals. By Rhenhardt Thiessen. Bull. 117, Bureau of Mines, 1920. 250 pp., 160 pl. For sale by Superintendent of Documents, Washington, D. C. Price, 80 cents.

Deposits of Manganese Ore in Arizona. By E. L. Jones Jr. and F. L. Ransome. Bull. 710-D, U. S. Geological Survey, 1920. Pp. 96, maps. From Contributions to Economic Geology, 1919, Part I.

Marble Resources of Southeastern Alaska. By Ernest F. Burchard. With a section on the Geography and Geology. By Theodore Chapin. Bull. 682, U. S. Geological Survey, 1920. 118 pp., colored plates, ill, maps, index. For sale by the Superintendent of Documents, Government Printing Office, Washington, D. C. Price, 40 cents.

INDUSTRIAL PROGRESS

INFORMATION FURNISHED BY MANUFACTURERS

ONE WAY OF CARRYING MINERS TO WORK

The accompanying illustration shows miners in the Cripple Creek district of Colorado traveling 'de luxe' to and from work. The adaptability of the motor-truck to operation on railroad tracks has made the four-mile ride of 35 men employed by the Cresson Consolidated Mining Co. to and from the mines as comfortable as riding in a pullman. The motor-

cap should be used to detonate it); (5) will not cause headaches to those who use and handle it; (6) made in all standard-size cartridges.

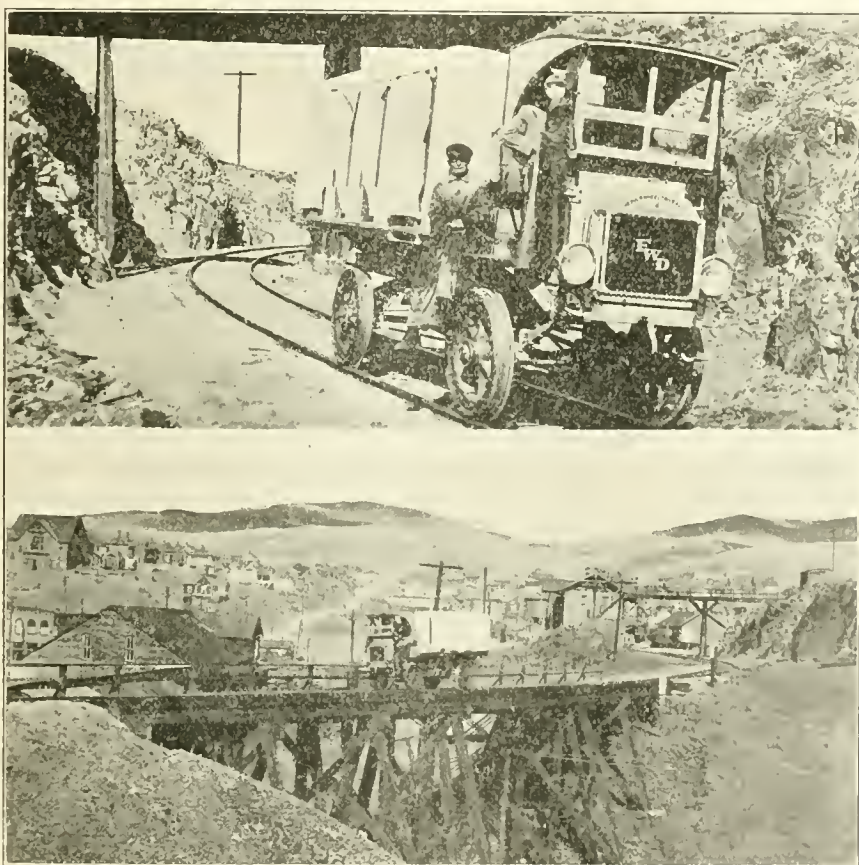
Making five different grades assures sufficient variety to meet every requirement. In order to determine which is the proper grade for a particular piece of work, it is advised that the consumer consult with the company and state exactly what the nature of the work is and what results are desired. The company's Service Division, which consists of men with expert knowledge and years of experience in the use of explosives, will recommend, after making careful investigation, the grade which will bring about maximum results.

It cannot freeze. There is great significance in this qualification. We can get an idea of what this means by reminding ourselves of the difficulties that the users of explosives must overcome when blasting in cold weather. If the temperature of the atmosphere is 40° or lower, a stick of dynamite becomes dangerous. No one is fool-hardy enough to attempt to use chilled or frozen dynamite, until he has thawed it completely. Many hazardous methods of thawing dynamite are being followed by blasters. The most common is by setting the sticks on end in front of an open fire. Another is placing the sticks in warm water. Other methods are to put the dynamite near or under stones or boilers, or on top of boilers. It is wrong even to suggest any of these methods, because they are extremely dangerous for many reasons. There is only one safe way to thaw frozen dynamite and that is to follow the methods recommended by manufacturers.

"Cannot freeze", applied to this new Giant explosive, gives positive assurance of an explosive which can neither be chilled nor frozen and which can be used and handled with no decrease in its effective-

ness in weather when the temperature is below zero. Here at last, is an explosive which defies all degrees of cold or heat, in which man may live, to change or affect its ingredients. All its qualities remain continually at the same standard in the heat of summer as well as in the extreme cold of winter. Because of this fact, thawing is not necessary and should not be attempted. There is no need to worry about the possibilities of a misfire or a poor shot on account of chilled or frozen dynamite. No need of taking the risk of inefficient loading which usually happens when the explosive charges must be placed hurriedly for fear of chilling.

That there can be no premature explosions is due to the great stability of Giant non-freezing. It requires a No. 6 blasting-cap to detonate it successfully. This means that



Motor-Truck for Carrying Miners to and from Cresson Mine

truck, a 3-ton FWD, which formerly was run over rough roads, has been equipped with flanged wheels and is now carrying its passengers in real comfort over the smooth steel rails that lead to the mines. Even the driver has protection from the elements in an all-weather cab.

AN EXPLOSIVE THAT CANNOT FREEZE

The Giant Powder Co., of San Francisco, has succeeded in producing a non-freezing explosive, the qualities of which are distinctive. Briefly, the qualifications of Giant non-freezing may be stated as follows: (1) five grades for every blasting requirement; (2) cannot freeze at any temperature; (3) withstands the heat of summer; (4) its stability avoids premature explosions (nothing weaker than a No. 6 blasting-

no ordinary blow or shake-up can be the cause of an explosion. Moreover, this stability remains unaltered and the explosive charge is always in perfect condition for effective detonation.

The elimination of headache is a feature which those who handle ordinary dynamite can appreciate, for, in the majority of cases, men experience a throbbing headache as a result of handling dynamite. Because Giant non-freezing will not cause headaches, the good-will and cheerful spirit of the men who handle it are retained. Every superintendent knows how vitally important this feature is.

THERMALLOY

A recent publication by the Electro Alloys Co. of Elyria, Ohio, for which E. Lavagnino of Pasadena, California, is Western representative, gives the following information regarding thermalloy. It is a high chromium alloy which remains unchanged under drastic thermal conditions. Laboratory experiments and industrial service tests extending over a period of several years have evolved in this alloy a combination of metals which is not affected at high temperatures by oxidizing or reducing conditions; nor will it absorb carbon or other injurious substances. High temperature, strength, and freedom from internal changes and transformations upon alternate heating and cooling prevent bending, warping, and cracking, so that containers or structural members of thermalloy retain their original form when maintained at the temperatures encountered in heat-treating or similar industrial operations. This alloy will serve for several thousand hours at 1800 F. and will give considerable life even at 2300 F. in intermittent service. Castings of thermalloy are uniform and free from blow-holes or segregations and can readily be made from $\frac{1}{8}$ in. up to any desired thickness and from an ounce or less in weight up to several thousand pounds. This alloy can be easily welded or machined for special requirements. Every stage in the production of thermalloy—the electric melting of selected raw materials under special refining slags—the molding and casting operations—finishing and inspection—each is subjected to the most careful control so that duplicate castings can be made under conditions which have been found best for this alloy. Physical properties are:

Melting point	2760 F.	
Specific gravity	7.60	
Weight per cubic inch	0.27 lb.	
Weight per cubic foot	467.00 lb.	
Coefficient of expansion, per deg. F.	0.0000088	
	Cast	Forged
Ultimate strength	60,000	120,000
Elastic limit	50,000	75,000
Elongation, two inches	1.5 %	16 %
Reduction of area	2.5 %	15 %

COMMERCIAL PARAGRAPHS

W. A. Leddell, formerly of Salt Lake City and Denver, is now associated with the **Hardinge Company**, with address at 120 Broadway, New York.

Robert P. Sanborn has been appointed manager of the traction department of the **Edison Storage Battery Co.** with headquarters at the factory and main office, at Orange, New Jersey. Mr. Sanborn is well known to the industry through a connection of several years in the power and mining department of the General Electric Co.

J. C. Thompson, secretary for the **Empire Tube & Steel Corporation**, reports the company recently booked orders for 350,000 ft. of tubing, which, together with contracts on hand, will keep the plant running at full capacity for the next 90 days. Many inquiries have been received, indicating a revival in the tube industry.

'Plymouth Locomotives in Road Construction' is the title

of a neat and informative pamphlet being distributed by the **Fate-Root-Heath Co.**, of Plymouth, Ohio. The Plymouth gasoline locomotive is a pioneer in the development of the gasoline type of industrial locomotive. It has been a pace-maker in the production of such locomotives in adequate numbers to meet the demand.

The **Coast Equipment Co.**, of San Francisco, for some time past doing business under the management of L. A. Somers, announces a re-organization under the control of L. A. Somers, H. S. Tittle, Alfred H. Potbury, and Robert Datzel Jr. L. A. Somers will be, as formerly, the manager for the company. Alfred H. Potbury will be the engineer for the company. The offices have been removed to 766 Polson street where, within a short time, a warehouse stock of meters, motors, transformers, and other equipment will be carried. The company specializes on electrical apparatus, turbo-generators, Diesel engines, Corliss engines, uniflow engines, mining and refrigerating machinery, cranes of all types, and complete industrial power-plants.

Two new educational motion-picture films of interest to the mining industry, 'The Story of Asbestos' and 'The Story of Sulphur', were ready for public distribution by the Bureau of Mines on March 1. 'The Story of Asbestos', in six reels, was produced by the Bureau in co-operation with the **H. W. Johns-Manville Co.** This picture illustrates in detail the methods employed in the mining of asbestos in Arizona and in Quebec, and also shows the manufacturing processes used at the Johns-Manville plants in New Jersey and New Hampshire. 'The Story of Sulphur' was produced by the Bureau in co-operation with the **Texas Gulf Sulphur Co.**, and shows in detail the methods of production, storage, and transportation employed at the plant of this company at Gulf, Texas. These films had their first public showing at the annual meeting of the American Institute of Mining and Metallurgical Engineers in New York.

The **Engineering Business Exchange** announces the opening of a Pacific Coast branch with James T. Whittlesey as director and with offices in the Claus Spreckles Bldg., San Francisco. This will make available to the engineers and engineering industries of the Coast States the same service in bringing together the buyers and sellers of engineering and technical business properties that is being rendered by the New York office of the Exchange. Mr. Whittlesey is well qualified for his work as director of this service. He was long a prominent figure in the street-railway field. He did some of the pioneer work in street-railway electrification on the Brooklyn street railways. For a dozen years he was chief engineer for the **Public Service Electric Co.**, of New Jersey. He built a number of that company's large power stations and developed a comprehensive ten-year program for the unification of the various plants and systems in New Jersey.

'Allis-Chalmers Corliss Steam Hoists' is the title of a recently published bulletin, No. 1803-A. The foreword of this excellent pamphlet says: "Allis-Chalmers Manufacturing Co. has an experience with hoisting engines and equipment covering half a century. This bulletin is in no sense a complete treatise upon the subject of hoisting-engines, nor does it attempt to catalogue them for ready selection by the purchaser. The aim is to suggest different types and designs to be considered in deciding upon a hoist best suited to individual requirements. No two hoisting problems are alike; therefore the selection of a Corliss hoist requires experience and engineering knowledge. A full and free discussion between purchaser and manufacturer of the hoisting conditions to be dealt with is advised in all cases before a definite choice is made. Our engineers are specialists in all matters pertaining to hoisting and are at the disposal of those who have such problems to deal with. We invite correspondence with anyone contemplating the installation of a hoisting-plant."



T. A. RICKARD, . . . Editor

DAVID R. FORGAN, of the National City Bank, says that "the business crisis has been passed and recovery, although slow, has been begun and will be sure."

THE high cost of railroad freight is indicated by the fact that there is now an all-water traffic between the Ohio and Mississippi rivers and San Francisco. Transshipment is effected at New Orleans. In spite of the Panama canal tolls, the saving in freight on certain articles between Cincinnati and the Pacific Coast is said to amount to \$1.65 per 100 pounds.

RUSSIAN anarchy is a cause of disturbance to the rest of the world in many curious ways. Thus Mr. Alpheus Williams, the general manager for the De Beers Consolidated Mines, stated recently that the depression in the diamond trade was due largely to the heavy influx of diamonds from Russian sources, the amount being valued at \$30,000,000, and representing presumably some of the salvage from soviet confiscation.

THE Secretary of War has stated that if reputable interests could be found to develop the Government nitrate plant at Muscle Shoals he would recommend to Congress that it should be handed over to them. An expenditure of \$30,000,000 is required to complete the plant. As the Government seems disinclined to rise to the occasion, an opportunity would seem to present itself to the large munition manufacturers, who made vast profits from the sale of explosives to the Allies during the Great War, to invest some of their surplus capital in an industry of prime national importance.

THE Western Precipitation Company, of Los Angeles, organized in 1907 for the purpose of administering the patent rights of the Cottrell process in the domestic field, and a sister organization to the Research Corporation of New York City, has the great advantage of being a commercial undertaking brought into being by the success of scientific investigation of a high standard. It can, therefore, call on capable men for the presentation of facts. We take pleasure in reproducing, on another page, a considerable portion of a pamphlet on the Cottrell process, recently issued, which deals with the history of electrical precipitation of suspended particles from gases, the theory and principle of the Cottrell process, the construction of precipitators and electrical

equipment, the factors entering into the design of precipitation installations, and the scope of the process generally. The article concludes with a bibliography of available information on the subject. It is free from brag or boast; the efficiency of the Cottrell process needs no emphasis. The frank narration of the history of electrical precipitation and the enumeration of the names of those who have added to the literature of the subject, from 1824 onward, is an evidence of scientific accuracy and a desire to be fair to all who, even in an indirect way, have contributed to the present-day success of the process. The Research Corporation and its sister companies command our respect.

IT is always a pleasure to draw attention to the catholicity of interest and achievement of mining engineers; it proves that success cannot be viewed only from the insular standpoint of the shoemaker and his last. We notice that Mr. Peter N. Nissen, whose reputation as a mining engineer and as the inventor of the Nissen stamp is well known, and who achieved distinction in the Great War as a lieutenant-colonel of the Royal Engineers and the originator of the 'Nissen hut' for troops, has designed and modeled a series of figures that are to form the group of statuary of the war memorial of the Institution of Mining and Metallurgy to those of its members who sacrificed themselves for the Great Cause. The roll of honor contains the names of 119 men, for whose devotion to duty and country Mr. Nissen's statuette will form an imperishable record.

THE English 'sovereign', or the pound sterling, has been legal tender in several foreign countries that do not mint their own gold coins. By custom and usage, foreign coinage is used in preference to national coinage in some places; the States of the northern Argentine use Bolivian money extensively. Honduras is making a drastic change by insisting that one-half of all customs dues be paid in U. S. currency, for every dollar of which two Honduras pesos will be allowed; in time it is expected that only American currency will be in circulation, as the Government is withdrawing its own silver coinage.

FEVERISH efforts to stimulate business in San Francisco are being announced in our daily press, and new slogans are being invented by the boosters. It is a process of raising oneself by the boot-straps, for it consists chiefly in indiscriminating self-praise and lyrical

recommendation of this city to neighboring communities. In short, it is entirely characteristic of our silly press. We mention this only because it brings into relief the auspicious fact that San Francisco can now boast a decent newspaper, the 'San Francisco Journal', whose motto is "All the news that's fit to read". Recently the other papers, controlled by the queerest kind of journalistic degenerates, have been swamped with putrid slush, detailing, usually quite untruthfully, the latest stories of debauchery and divorce, immorality and murder. It is a relief to read a paper free from this filth, and to find the real news of the day recorded tersely and intelligently. The editorial writing of the 'Journal' commands respect and does credit to Mr. Andrew M. Lawrence, the editor and publisher. We wish him every success. It will mean much to San Francisco if a clean paper can become firmly established in our city. The address of the new paper is 182 Jessie street, San Francisco. Send for a copy and examine it for yourself; then aid the good work of creating a healthy state of public opinion by subscribing for the 'Journal', thereby helping to put the yellow press out of business. That is one way to keep democracy safe for your children.

THAT Germany will again become a menace to the peace of the world unless the Allies suppress the present German supremacy in the matter of synthetic-dye and nitrogen-fixation plants, is the opinion of Dr. Marston T. Bogert, who spoke at Wilmington recently. It is pointed out that dye plants can be immediately converted into poison-gas manufactories; the nitric acid, produced by synthesis, is just as essential a foundation for the manufacture of explosives as of fertilizers. Germany's export trade, we are told, must be carefully regulated, for this phase of commerce is often used as an excuse for the maintenance and expansion of colossal plants of a character that hide latent military uses. The chief of staff of the U. S. Army, in opposing an extension of the Chemical Warfare Service, has suggested that poison-gas production in Germany can be prevented by stopping the importation of primary substances used in its manufacture. But to emasculate the German chemical industry would mean, according to Dr. Bogert, the closure of all the salt and sulphur mines, the prohibition of sugar-beet cultivation, and the entire destruction of the forests. This would still leave the air, which, in the hands of German chemists, forms an excellent raw material for the production of explosives. We question the advisability of the suppression of German industry and initiative for no other reason than, to quote Dr. Bogert, because "there will be no safety for this country until we have a development of these vital industries [synthetic dyes and nitrogen products] superior to that of Germany". In both respects we owe much, if not nearly all, of our knowledge to German chemists. What do we need to beat the Germans in this field? It cannot be capital, for Germany is beggared. It cannot be raw products, for we are in an equally, or more, favorable position than they are. Perhaps we have less of the scientific spirit that gave

Germany her supremacy in such work. If we can learn the lesson of cause and effect from those German chemists who are being engaged to work in the United States, then the immigration of such men should be encouraged. Germans of high standing in science and technology make good citizens; we are proud to know many of them as loyal Americans.

SCHOLARSHIP in college apparently is a reliable index by which to foretell the degree of eminence in his profession that a graduate of a technical school is likely to attain. Mr. Raymond Walters, professor at Lehigh University, has compiled some interesting data regarding the college career of 392 technically educated engineers who, during the period 1915-1919, served as officers, special representatives, or as members of important committees, for the four 'founder' American engineering societies—that is, the national organizations of mining, civil, mechanical, and electrical engineers. For purposes of comparison, five degrees of scholastic attainment were assumed, based on the standing of the individual student among his fellow-classmen at the time of graduation. It was found that of the 392 engineers, 182 or 46.4% had been in the first or highest fifth; that 109 or 27.8% stood in the second fifth; and that the proportions in the succeeding groups were 18.3%, 3.6%, and 3.8%. The American Association of Collegiate Registrars, of which Mr. Walters is a member, has prepared a larger list of 730 distinguished engineers; of these, 80% are university graduates and 5% more have had some college training, but are not graduates. The arbitrary method of determining the professional standing of an engineer on the basis of his prominent participation in institute or society affairs is open to criticism, of course, but on the whole it seems as good as any. That the Collegiate Registrars should choose such a basis seems to endorse our view that there is a relation between membership in the Institute and professional status, as discussed editorially in our issue of February 19.

The Shut-Down

Last week, just after we had gone to press, the decision to suspend operations at a number of copper mines was made known. The companies participating in this act of policy were the Anaconda, the Inspiration, the Phelps Dodge Corporation, the Calumet & Hecla group, and the four big 'porphyry' enterprises, namely, the Utah, Ray Consolidated, Chino, and Nevada Consolidated. Other companies will follow suit, so that a general temporary cessation of copper mining is imminent. This is a step that is as unpleasant as it was inevitable. The stocks of metal were not being diminished, despite every effort to do so; the curtailment of production during recent months had been considerable, but it had not sufficed to correct the state of post-bellum congestion that was bringing the market to a condition of collapse. It is evident now, of course, that this step ought to have been taken two years ago, when the signs pointed so clearly to a heavy decrease in the consumption of metal; if the

mine operators had taken their medicine then, they would have been in much better economic health today. They postponed the evil day, hoping against hope, and blinking at statistics, until finally they summoned the courage to do the necessary thing. Meanwhile consumers have postponed the buying of copper in the expectation of a further decline in the price; they will now realize that every pound of metal they buy henceforward will be on a rising market, because there will be a relatively insignificant flow—a mere trickle—of production. In short, the law of supply and demand will be given free scope to redress the balance.

The decision of the copper companies will cause much suffering in the communities dependent on the mines. In Montana a failure of crops and in Arizona a collapse of the cotton market have already inflicted hardship on the population. The closing of the copper mines will be keenly felt. However, without any special information on the subject, we hazard the guess that the period of suspended animation will not be long. The domestic consumption of copper is enormous and will soon wipe out the accumulation of metal that has so long menaced the market; but, before industry can be restored to normality, it is imperative that the rate of wages be brought down in conformity with the deflation of commodity-values. We are going through the irritating process of post-war deflation, and it is one that must affect everybody, both as a matter of justice and of economic equilibrium. The profiteers of capital have had to toe the mark; the profiteers of labor must face the music and accept their share in the readjustment. Such a readjustment to the new conditions might have been effected by adopting or enforcing a lower scale of wages, but it would, presumably, have involved much friction and ill feeling, culminating in strikes, and disorder. The miners and other day-laborers would have resented the reduction, and, what is more important, they would have failed to understand the need for it, the economic equity of the process. So the managers suspend operations, and thereby cause the men to realize the basic fact that copper can only be produced at a loss so long as wages are abnormally high and the market is abnormally weak. When the announcement of the shut-down was made, the share-market became stronger, because it was realized that the shut-down stopped the loss due to operations that yielded copper at a cost above that at which it could be sold. In short, the event is an object-lesson in economics; the effect will be sad but salutary to all concerned. We believe, now that the critical step has been taken, that the market will be restored to health. The mining of copper in the United States is not in a parlous state; the industry is going through a crisis that has been impending for a long time, and it will recover shortly to normal health and vigor. The mines may be idle for a time, but the consumption of copper will continue unabated. This will cure the malaise from which the industry has been suffering since the Armistice, and it was the only way to cure it. We extend our sympathy to the hundreds of technical men thrown out of employment, and commend to them the French

proverb that says: "All things come to those who know how to wait". Most people quote it incorrectly, omitting the qualification of knowing how to wait, that is, making use of the time of waiting. Some will take a well-earned holiday, with healthful exercise; some will use the time in research and study; some will do a little prospecting on their own account. We venture to advise our friends in the profession, during their enforced inaction from regular work, to do anything rather than loaf aimlessly or repine hopelessly. Mining, and copper mining especially, is not coming to an end; on the contrary, this basic industry is destined to increased expansion in accord with the ever-developing requirements of our civilization, which is built upon the application of the metals for the use and benefit of man. Gentlemen, be of good heart!

Conditions in Mexico

Our correspondent in Mexico sends us some interesting notes on the progress of reconstruction in that country. General Obregon has accomplished much already. Undoubtedly the way in which he put an end to the recent strike on the railroads indicates his purpose and ability to maintain order. Our correspondent excuses the arbitrary methods of the Government on the ground that the members of the National Congress are incompetent and negligent, having failed to pass the laws necessary to meet new conditions. The opponents of President Obregon seem to be discredited and scattered, and meanwhile the menace of military brigandage is being lessened steadily by the disbanding of superfluous troops. We are glad to note that our own cheerful views regarding the future of Mexico are confirmed by Mr. R. T. Bayliss, a thoughtful and conservative observer of current events, who, as chairman of the Exploration Company, in London, referred to the subject in a recent speech delivered by him at the annual meeting of his company, which retains large and important mining interests in Mexico. He said: "The position in Mexico today is, I think, vastly improved as compared with a year ago. There is, however, a great deal to be done, and there are many reforms to be established before it attains to the degree of economic and industrial stability that its friends desire. . . I am afraid people in Mexico are expecting too much a little too quickly from the present Administration. After the deposition of President Carranza of unhappy memory, and during the provisional presidency of Señor de la Huerta, great expectations were formed, and confidence reposed in the benefits which would result from the election of General Obregon as the President of the Republic. The feeling in Mexico today, as I understand it, is rather one of disappointment that he has not already made more rapid advance toward the many schemes of reform and progress of which the entire community is so much in need. I think this is hardly fair. . . Notwithstanding this feeling, there can be no doubt that conditions throughout the country are today more peaceful, and show more evidence of a return to normal than at any time during the past

ten years." He instanced the safety of travel and the decided improvement in railroad traffic. He suggested that the increasing revenue from exports of oil would restore the financial stability of the country, despite the fall in the price of silver. As to that, it was not "an unmixed evil, for it has involved a complete readjustment of the labor situation, which was getting quite out of hand." By way of concluding his review of conditions in Mexico, he stated: "I am, therefore, encouraged to increase our interests in Mexican mines as and when good ones are brought to our attention, provided they can be acquired at reasonable prices, having regard to the post-war conditions that prevail." Those who know Mr. Bayliss, or know of him, will be glad to have his views on the matter. For ourselves, we know him to be a sagacious man and believe his opinions to be justified by the facts.

The Valuation of Mines

Valuation of partly exhausted mines is the subject of another article, in this issue, by Mr. Morton Webber. It is, in effect, a sequel to the one printed in our issue of March 19. Speaking generally, it may be said that mines in a thoroughly healthy condition of development are rarely offered for sale; it is the sick ones that are offered, because the restoration to health, presuming it to be possible, calls for the expenditure of more capital than the owner has at his command. Usually the first question that the investigating engineer, representing a putative purchaser, has to ask is: Why is the property on the market? Having ascertained the cause, the engineer has to decide whether the unfavorable feature can be remedied; that is, whether the enterprise can be restored to healthful productivity without spending more money than the result would warrant. Mr. Webber makes this clear in his article. We note his references to previous writers, with whom perhaps we are better acquainted than he is and of whose work we are more appreciative. Mr. J. H. Curle is no longer writing on the subject of mine valuation; he is traveling in distant parts or he is doing patriotic work. During the War he was a notable exponent of thrift, devoting his time and energy toward inculcating, publicly, by speeches, the need for an abatement of personal extravagance. It is many years since he first made a name for himself as a writer on mining economics, and so many others have followed in his trail that his footsteps are almost obliterated; but we saw them when they were fresh, and we recognize their value in guiding the public to a proper understanding of the mining business. Mr. Curle's suggestions were no more "rule-of-thumb methods" than those of his successors; they were approximations toward basic principles and they expressed the teachings of world-wide experience. By putting them in plain words and in definite shape, he made himself understood, and also laid himself open to technical criticism, as is usually the case when men dare to come down to earth by making a concrete statement, instead of dealing in mere abstractions. Another writer to whom Mr. Webber refers in a foot-note is Mr. M. H.

Burnham, whose articles on 'The Finance of a Mine' we had the pleasure of reading before their publication ten years ago. Mr. Burnham's style was more didactic than that of Mr. Curle, and his mental attitude was jaundiced somewhat by the unfair treatment he had received from an unsympathetic chief, but he also did pioneer work of undoubted value. His mathematical demonstrations may have intimidated all but the more serious students of the subject, and his use of formulas may have annoyed the more sophisticated; nevertheless, he had logical ideas and he expressed them forcibly in the series of articles that appeared in 'The Mining Magazine' in 1911. He did excellent service in making clear the fact that risk is essential to such a speculative business as mining, and he made it equally clear that the speculator in mines should expect to receive not only a bank-rate of interest on his money, but as much more as will cover the greater risk. Experienced engineers had this idea at the back of their heads, of course, but Mr. Burnham brought it forward and gave it convincing expression. Likewise he discussed shoot-extension and deferred dividends in an illuminating and suggestive manner. He and his predecessor, Mr. Curle, did much to clarify current ideas on the economics of mine valuation, and we take pleasure in recognizing the value of their writings as contributory to the more enlightened views held today by those engaged in mining enterprise.

Mr. Webber quotes five examples to illustrate his discussion of underlying principles. Those illustrations are taken from life, so to speak, and lend force to his rationalizations. Indeed, as we have suggested more than once, what we need most is a series of post-mortems on mining ventures, that is, a study of the original reports on which important mines were purchased, as well as the subsequent record of their performance, making clear in what respects the estimates or forecasts of the examining engineers were correct, and in what respects they were wrong. The report on a mine may be vitiated by the fact that, subsequently, it is not exploited in the manner anticipated. For example, the engineer may base his valuation on the expectation that the lode will be mined as a narrow vein of high-grade ore, whereas the manager may decide to treat the lode as a wide body of low-grade material. The reverse may happen, a series of wide low-grade stopes giving place to narrow openings from which clean high-grade ore is removed by 'resuing' or stripping. Another disturbing element arises from the inherent difference between sampling and mining. The sampling aims at an exact average; the mining is essentially a selective process. The failure to recognize this difference explains many unpleasant discrepancies between forecast and fulfillment. The valuation of mines will never be an exact science, because it involves too many indeterminate factors, including the personal equation, but it can be made less inexact, and to that end we desire to promote discussion both of principle and of practice. We hope that members of the profession interested in the subject will not hesitate to give to Mr. Webber the compliment of discussing his latest articles.



Standardization of Mining and Milling Materials

The Editor:

Sir—Articles appearing in the 'Press' from time to time with reference to steel for mining purposes, and particularly that by E. A. Wraight in your issue of March 12, have greatly interested me.

I have made an exhaustive study of this question, more thorough, I believe, from a steel manufacturer's standpoint, than has ever been made by anyone else, and being a steel metallurgist with practical experience in the making and working of high-grade steels, believe I am in a position to throw considerable light on the question, but think you would probably be reluctant to print such an article as your readers might conclude that I was after some free advertising.

There are two very good reasons why better steels are not offered by the manufacturers to the mining industry. First, the steel-maker has found from experience that the mine-operator in a great majority of cases is only interested in the first cost of the steel or the finished wearing part, and not in the ultimate cost, which is really the only cost that should be considered. For this reason the steel manufacturer has decided that it is entirely too expensive a proposition to try to introduce a high-grade article. Second, the steel-manufacturer is located at a considerable distance from the mines and will not go to the trouble or does not think it worth while to investigate the uses to which his steel is put, and the mining man does not have sufficient knowledge of the manufacture, working, and treatment of steel to make the steel man understand what he requires.

I have made some very interesting experiments with wearing parts of crushing machinery from various steels, and the results have been truly remarkable. In one case I tried some stamp-shoes of different steels and treatments in one of the most modern mills in the West, and these shoes lasted from 170 to 190 days as against 120 days for the best shoe used previously. The first cost of the high-grade shoe was low enough to show a decided advantage as to ultimate cost or cost per ton or ore crushed.

The steel manufacturer knows how to make better drill-steel and better parts for crushing or grinding machines. They also know that this steel will cost more and that the expense of introducing it is too great to warrant the attempt.

I have made analyses of wearing parts such as stamp-shoes, grinding-balls, and drill-steel from a great many

different mines, and find that the better grades were all practically the same analyses and that these steels were the same as those used by mining companies 20 years ago. Some of these steels were made in Germany and other foreign countries. I know of no other industry that has advanced so slowly along this line as the mining industry.

As soon as the mine operator learns that a high-grade article cannot be produced as cheaply as an inferior article and that he must figure the ultimate cost or the cost of steel per ton or ore crushed he will get the steel that will reduce his costs.

G. F. HICKOK.

San Francisco, March 23.

Pyrite in the Huelva District, Spain

The Editor:

Sir—For the sake of accuracy, two slight errors in my articles on the pyrite district of Spain deserve correction. In your issue of January 22, page 127, referring to the parallel series of diabase outcrops accompanying the pyrite deposits across the province of Huelva the print makes me say that "These intrusions are traceable continuously on the surface." This is precisely the opposite to what should be stated. They are *not* continuous; they appear at intervals, as is stated immediately afterward in the same article. The outcrops of basic rock represent portions of dikes that apparently did not originally reach the surface, but have been exposed on their higher points by erosion.

Again, in the article on cementation practice in the province of Huelva (which is exactly similar to that followed at the Rio Tinto property), in your issue of February 5, page 189, the analysis of the solutions in cementation is said to be reported in "parts per billion". As such analyses are universally reported in parts per million the technical reader could hardly interpret this wrongly, but it is desirable to call attention to the error so as to avoid possible misinterpretation.

New York, March 15.

COURTENAY DE KALB.

Cutting Metal With a Steel Disc

The Editor:

Sir—The article by Thomas W. Cunningham, on oxy-acetylene welding and cutting, prompts me to draw attention to the use of a steel disc for the cutting of piping and other light articles. At a Chilean nitrate oficina recently we needed a large number of comparatively short lengths of 2-in. steel pipe, to be cut to an angle of

45 for welding. Insufficiency of oxygen at the plant prevented the use of the oxy-acetylene equipment for the purpose. The engineer, J. P. McElhee, suggested the use of a circular steel disc, running at a high speed, and operated on an ordinary saw bench. The cutter, I believe, consisted of an old circular saw blade, from which the teeth had been removed. As far as the practical success of the application of the idea was concerned I must confess that I was 'from Missouri'; but conviction as to the effectiveness of the method was soon forthcoming. The cut was made, the disc running at ordinary circular-saw speed, through a 2-in. pipe in about 30 seconds, and without pre-heating. Comparatively little heat resulted in the disc, the edge of which was roughened occasionally with a few cuts made with a cold-chisel.

I presume that this process was a simple though unconscious application of the principle of oxidation utilized in the oxy-acetylene cutting flame. Friction between the steel disc and the pipe produces enough heat to permit the oxidation of the surface of the metal in the presence of the rapid stream of air (oxygen) delivered by the motion of the disc. The idea was new to me; it may be of service to other readers of the 'Press'.

San Francisco, March 16.

A. W. ALLEN.

Mining in Dutch Guiana

The Editor:

Sir—In response to the two questions asked by Mr. A. P. Rogers in his communication appearing in your issue of March 19, I would say: If he will read again the third paragraph of my letter in your issue of February 26 he will find the matter of "profits derived from the 60,000 tons handled" covered fully.

As to his "cross-cut adit", all such parts of it as lay in front of the excavation shown, and have been reached to date, have gone through the mill, and the balance is traveling the same road. The remains can be found in the tailing-pit, if wanted.

Denver, March 22.

THEO. F. VAN WAGENEN.

Nickel Production

The Editor:

Sir—In the edition of the 'M. & S. P.' of January 29, 1921, and on page 160, the paragraph regarding the nickel production of New Caledonia has aroused a certain amount of ire among the mining men and prospectors. Being an old reader of your journal I have assured those who have kicked that full amends will be willingly made.

On page XXX of the Report of the Ontario Nickel Commission, published in 1917: "When the Sudbury industry began practically the whole of the world's demand for nickel was supplied from New Caledonia. In 1900 about 65% of the world's nickel supply came from New Caledonia and about 35% from Canada. The world's output has increased fivefold since that time and now Ontario produces over 80% of the whole. The production in Ontario in the last 15 years has increased nine-

fold, the production of New Caledonia by less than 20%."

Sudbury has produced from 1887 to 1916, 284,838 tons of nickel and 175,003 tons of copper, and New Caledonia has produced from 1875 to 1915, 156,394 tons of nickel.

A comparison of tables shows that of recent years the production of Ontario has been growing much more rapidly than that of New Caledonia. Figures for the last three five-year periods bring this out very clearly:

Years	New Caledonia Tons	Ontario Tons
1901-1905	33,600	31,616
1906-1910	31,973	62,718
1911-1915	39,607	121,106
	<hr/> 105,180	<hr/> 215,434

The above data are also taken from the report, pages 195 and 499.

I bought your book on 'Technical Writing' and have read it over twice. Now it is going the rounds among the staff, and the catching of you, Mr. Editor, in an Irish bull shows what it has accomplished: viz, on page 147 of same issue (January 29, 1921), you state that "The leader of the Irish rebellion, a man of Spanish birth and born in New York, etc." This probably accounts for De Valera's elusiveness.

WM. A. FLYNN.

Cobalt, Ontario, March 25.

[A person is of Spanish birth if his father is a Spaniard, because Spanish is an adjective referring to a race, as well as to a country. We agree, however, with Mr. Flynn, that 'Spanish parentage' would have been preferable. His statistical note is welcome; the one that he corrects was a 'filler' at the bottom of a page, and not a part of an editorial or an article. We are glad to have it corrected.—EDITOR.]

Drill-Steel

The Editor:

Sir—As chairman of a committee of the Canadian Engineering Standards Association on drill-steel I have followed the general interest in the subject.

With regard to breakage it appears to be the general experience of operators that it is greater with unmounted than with mounted drills. The feed-screw of the mounted drill supplies a reasonably constant pressure. In the unmounted drill the drill chatters on the steel and the steel chatters on the rock, with resultant crystallization and breakage of both.

This is only a detail in the general question, but seems to warrant attention.

O. HALL.

Coniston, Ontario, March 16.

THE provision of a grizzly underneath a rock-breaker delivering to a conveyor-belt, and arranged so that the undersize from the grizzly is made to form a bed of fine material to receive the coarser, usually results in a material lengthening of the life of the belt.

Valuing Partly Exhausted Mines—II

Examining Mines Largely Exhausted Within Development Exposures

By Morton Webber

The examination of badly gutted mines is a phase of mine-valuing that will become increasingly common. This is due to the following main causes: (1) Mines in a healthy state of balance between ore-reserves and production are seldom offered for sale. Their owners usually feel that they can do better by operating privately or by placing their shares on the stock exchange. (2) Intensive production during the prevalence of war prices without coincident intensive development. (3) The collapse of base-metal prices, the aftermath of the War, when companies continued to market the high-grade portions of their deposits to avoid the loss of organization through closing down. To companies in a poor financial state the persistence of low-metal prices may mean the sale of the mine to stronger financial interests or some other radical form of re-financing.

The examination of such mines is probably the most difficult phase of mine-valuing. Their purchase may, however, offer attractive possibilities of large profits. The owner of a 'down-at-the-heel' mine is not in a position to trade; and the production of the past is an index of the possibilities of the future. The buyer should be able to obtain an option that will allow him to develop the mine and determine its future possibilities before being required to pay for it. If the exhausted state is owing to artificial causes, as described above, the presumption is that the mine will make good. This optimistic statement is predicated on the mine having been a profitable enterprise prior to the artificial or external conditions that provoked financial suicide.

The engineer, when called upon to examine such a mine, must eliminate rule-of-thumb methods that utilize the net value of the ore-reserve as a factor in appraising the future life of a mine. He must realize, what I attempted to illustrate in a previous article, that the ore-reserves of a mine above the lowest level and the life-extension below are distinct propositions. An artificial condition within development exposures cannot alter the economic merit of the mine beyond exposures.¹

This may be expressed in another way. The extent of the ore-reserves is largely a matter of management. A mine with a moderate output in proportion to its size, accompanied by energetic development, will show a relatively large ore-reserve. Should the same mine have been subject to intensive production, accompanied by weak development, the result will be relatively a small ore-reserve. The sequential point is that the same mine under

different policies of management will present great disparity in ore-reserves above the bottom on any given horizon; yet the life-extension beyond development exposures is identical. Rule-of-thumb methods that use the net value of ore-reserves as a factor in estimating the present value of the future life, such as the so-called 'Curle law', would arrive at radically dissimilar valuations of the future of the same mine.² I do not mean that a mine with a large ore-reserve is not more valuable than the same mine when gutted; the point is that the value of the possibilities beyond exposures and the remaining net ore within exposures are distinct propositions. By failing to realize this, opportunities have been lost of buying a good mine cheaply. Many engineers regard ore-reserves as essential to a sale. They realize that future possibilities is what the buyer wants, but they rely on exposed ore as the mainstay. They feel that if the bottom of the mine 'goes back on them', at all events they will have the exposed ore to fall back on. The inevitable balance-sheet of what money was put in and what came out is only postponed.³

The prime effect to the purchaser of ore-reserves in the great majority of mining deals with which I am familiar is that they required more money to swing the deal. The vendor merely added their net value to the price. There was no profit in the individual purchase of the ore-reserves, and their existence demanded a cash form of purchase, which committed the vendee before there was sufficient time to perform development in depth to ascertain if the extension of the orebodies was attractive.

¹'The Gold Mines of the World', by J. H. Curle. The author recommended that, as a basis of valuing gold mines, at least 60% of the price should be represented by net profit in developed ore. In addition to this the ore exposed in the bottom level of the mine should be equal in length, width, and grade to the levels above and the enterprise should be capable of earning at least 15% on the investment. In a series of articles entitled 'The Finance of a Mine', by M. H. Burnam, which appeared in 'The Mining Magazine' of London, 1911, attempt was made to value the future of a mine by formula depending on the risk rate arrived at from exposed ore. The same criticism would apply as the quantity of ore-reserves may be largely a result of development policy.

²A striking example is the Santa Gertrudis mine, at Pachuca, Mexico. This property had a large proportional ore-reserve at the date of examination by the engineers of the Camp Bird, Ltd. The large ore-reserve gave the mine an excellent appearance and a heavy price was paid for the future beyond exposures. It is doubtful, when the mine is finally exhausted, if the purchaser, after debiting the purchase price, will make a profit commensurate with a mining risk.

³'Ore-Reserves and Life-Extension', by Morton Webber, 'M. & S. P.', October 19, 1912.

Some years ago I was indirectly connected with a large deal on a gold mine in Nevada. The property was fully developed and also had a large null; it was on the market because the owners had become financially embarrassed. The mine was particularly attractive on account of its development and equipment, and considerable competition in its purchase was forthcoming from several large exploration companies. I was willing to examine the mine for a client on the basis of an option for \$1,000,000. I felt, however, after carefully going into the exhaustive reports by the engineers of the vendor—engineers of the highest repute—that the figure the owner asked would equal the entire net value of the ore-reserves, plus the cost of existing equipment. If the ore did not persist in depth, my client would just get his capital back without interest. My negotiations were knocked on the head by the competition of a large exploration company. They offered \$987,000, one-third after examination, and the balance in 90 days, the entire sum being guaranteed by a bank. As this was much more certain than my offer and as I was not sufficiently enthusiastic to do better, they got the mine. Further development was particularly unsatisfactory, and owing to a large latent sampling-error in the estimation of the ore-reserve, it is doubtful if the purchaser will get the capital back without reference to interest.

The point I make is not that an owner is, or is not, entitled to charge for net value of ore-reserves, plus plant equipment and a present valuation of the future possibilities. I use this example to show that the existence of ore-reserves demands purchase conditions that, if the future beyond development exposures is not satisfactory, will result in a first-class ease of 'changing dollars', and frequently the loss of the original investment. In the example cited, if it is assumed that the mine had been gutted to the lowest level existing at date of these negotiations, an exploration option could probably have been arranged permitting the opening up of two new levels as an initial-risk program before purchase payments were demanded. This work would have cost, say, \$100,000. The buyer would be ahead in this particular case at least \$500,000 after debiting \$100,000. He also would have saved interest on the purchase price to the date he can get his money back into the interest-earning market.

Theoretically it is better business to buy a gutted mine with a good bottom than the same mine with an important quantity of remaining ore above the lowest level. The purchase of an ore-reserve equal to, say, three years output has always appeared to me much the same as buying three discount-notes of from one to three years with the purchaser assuming the risk of the metal market.

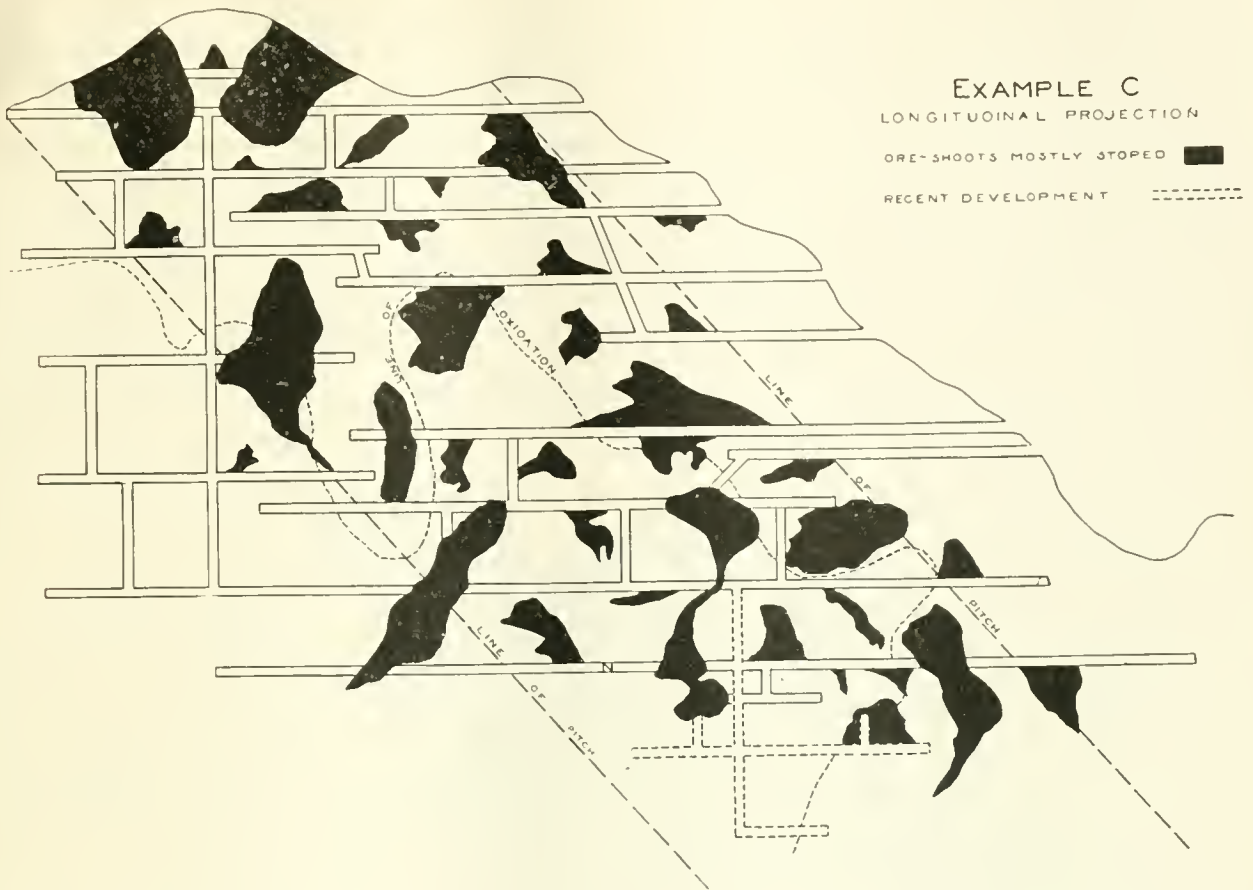
Apart from these engineering features, the psychology of bargaining must be considered. As long as mines are bought and sold, so long will the seller want as much as he can get, and the purchaser will want to pay as little as he can. Real traders recognize this and remain friends. It is the hypocrites who are super-sensitive and quarrel. The security the engineer hopes to find in ore-reserves, which, for the reason stated, is often a questionable means

of safety to the buyer, is a vital security to the seller. He can attract various purchasers. His window is dressed and he can exhibit his wares to advantage. If necessary, he may operate the mine himself. He is in a position to trade. The owner of a gutted mine, with a good bottom, is often incapable of rehabilitating his property without fresh capital. The workings are so depressing in their exhausted state that it requires the highest skill when appraising future possibilities to realize that the condition is artificial and transient. In short, the owner of such a mine must take the best he can. In view of these facts, which are virtually axiomatic, it is difficult to understand why some development companies continue to hold out for the so-called 'fully developed' mine. Many of their engineers realize the arguments above presented and have beat against their stereotyped requirements with amazing patience.

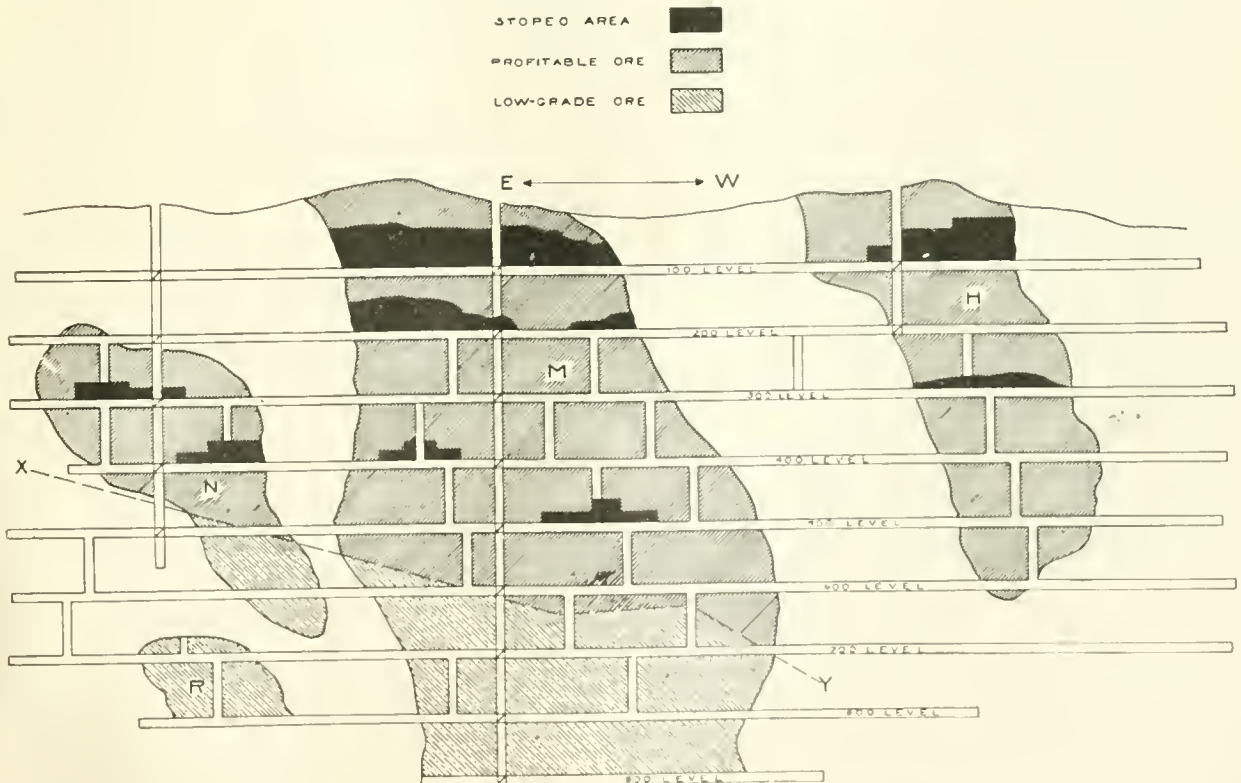
In order to change from the foregoing negative argument, which was necessary to appropriately substitute constructive suggestions, I will now offer two longitudinal projections of mines I have examined. Example C is a copper mine that has paid in dividends nearly \$1,000,000. It was almost entirely exhausted of standing ore when examined. It was composed of a series of recurring metamorphic replacements. The orebodies were found in a garnetized area, which was a marginal phase of a contact between lime and granite. Example D, also a copper mine, was composed of a series of lenticular orebodies in schist. In the space afforded it is impossible to deal in detail with the geology. I shall confine myself to the main economic factors, geological and engineering. With their aid I believe I can prove that the state of the ore-reserves of a mine above the lowest level may be due to artificial causes and may not illumine the possibilities of the future.

In example C the black portion represents the stoped areas. At the date of my examination most of these orebodies were worked out. The stoping then in operation was evidently confined to the upper portions of the ore-shoots. This was evident from their tapering out or wedge shape. Development was being done in a perfunctory manner, and there was reason to believe that the character of the occurrences of the orebodies was not properly understood. The future possibilities of the mine appeared to me to rest on the following main factors:

1. The total quantity of profitable ore exposed in the past without reference to what may or may not remain standing.
2. The frequency of the occurrence of the shoots.
3. Did the shoots increase or decrease in size with depth?
4. Did the shoots assemble closer together with depth, or did they spread out, entailing increased development expense in their search?
5. Did the number of shoots increase or decrease with depth?
6. Did the horizontal base line increase or decrease with depth?



EXAMPLE D
LONGITUINAL PROJECTION



7. Was the profitable nature of past operations due to secondary enrichment? If so, how far would mining operations below the present bottom be likely to continue before reaching the bottom of the enriched zone?

There were, of course, many other factors that entered into the consideration of the future possibilities in respect to production cost, such as the economies to be effected by introducing local treatment and improved mining methods, but the foregoing were the main factors in arriving at the future possibilities of the mine as a producer of ore. What ore was remaining above the lowest level as the result of circumstance had nothing to do with what should be expected in, say, another four or five new lifts.

As the mine contained about 18 miles of underground workings and up to the date of examination had disclosed about 40 ore-shoots of varying importance, difficulty was experienced in intelligently considering these factors in their proportional relation. The workings were too extensive, and were too varied in direction and importance, for the engineer to get properly oriented when underground, even if aided by maps. It is one thing to get to know a mine of this size under the daily duties as manager, and a very different matter to get a balanced perspective in the short order demanded of an examining engineer.

To meet the situation I made a glass model of the mine. There were 26 panes of glass, a pane to each level. These levels were spaced vertically to scale by means of intervening blocks of wood. Each level was painted solid. The paint was bicycle enamel and each level had a different color. This established the pitch of the recurring ore-shoots and the information required to obtain factors No. 2, 4, 5, and 6.

The model could not furnish factors No. 1, 3, or 7. The reason why factor No. 1 was not furnished by the model is elementary and will not be discussed. In respect to factor No. 3, as a pane of glass could only illustrate the plan of the level, it only disclosed the horizontal section of the stope on this plane. As the stopes varied greatly in size and shape, it frequently happened that some of the largest stopes appeared quite small in area on the plan of the levels. For example, a stope might be only 10 sets in plane area at the level intersection, and between this level and the level above it might widen out to, say, 70 sets, and when intersected by the level above it might be down again in area to, say, 8 sets.

The information necessary for factor No. 3 was obtained as follows: A book was compiled of all stopes in composite plan and two vertical sections, and their area obtained by planimeter. Each stope was numbered and the number was painted on the pane where the level intersected the stope. The model was lighted by are-

lights from below. It was easy, therefore, to take any level, by studying the model in conjunction with the stope book, and compare the area of the stopes connected with this level with that obtained by other levels above or below.

Factor No. 7 was an important feature in favor of the mine. The line of transition from the oxidized zone to the sulphide zone is indicated on the map. It was very irregular in elevation, but the change was invariably abrupt. Migration and re-precipitation were relatively nil. At the margin of the zone of oxidation there were only unimportant quantities of secondary bornite, and this quickly shaded into chalcopyrite and primary chalcocite carried in a vehicle of iron pyrite and pyrrhotite. The shipments from each level from top to bottom showed no reduction in the copper content; in fact, the sulphide ore was richer in copper than the oxide ore. As the sulphide ore was primary the profitable continuance of the mine in depth was not dependent on a zone of secondary enrichment. In addition to this, there seemed to be no increase in depth in the ratio of non-cuprous pyrite and pyrrhotite to the copper minerals. The evidence pertaining to the future seemed to be that as long as the recurring replacements were found they would be of profitable copper content, provided they were big enough and were sufficiently numerous. This vital issue was illuminated by factors No. 2, 3, 4, 5, and 6.

In respect to factor No. 6 it will be noticed that the base-line remained the same with depth. By this I mean that the longitudinal length of the ore-zone from the most northern shoot to the most southern on each level remained the same. There was a pronounced pitch of this zone from north to south, with the base length remaining uniform.

I have used considerable space in describing this examination. My object, I trust, will now be evident. I believe I have proved that the extent of standing ore within development exposures has nothing to do with the future possibilities of the mine. The only index of the future existing above the lowest level is the total quantity of profitable ore found. Whether much or little of it remains as the outcome of circumstance is of no importance. If an important quantity is left standing, the buyer will have to pay for it and it will require just that much more money to swing the deal and acquire title to the life-extension of the enterprise. In fact, the psychology of business and trading is that, apart from the fact that the buyer has to pay for the ore irrespective of the value placed on the future possibilities, he will find that the price placed on the life extension varies directly as the ore-reserve. If a certain mine with a good bottom can be bought for \$500,000, with, say, \$200,000 assured, it will be admitted by engineers experienced in negotiating options that if the same mine had \$400,000 assured at the same horizon, the property would cost very much more than \$700,000. It is probable the owner would want about \$1,000,000. In other words, the price asked for identically the same future possibilities would increase from \$300,000 to \$600,000, or 100%, and the owner

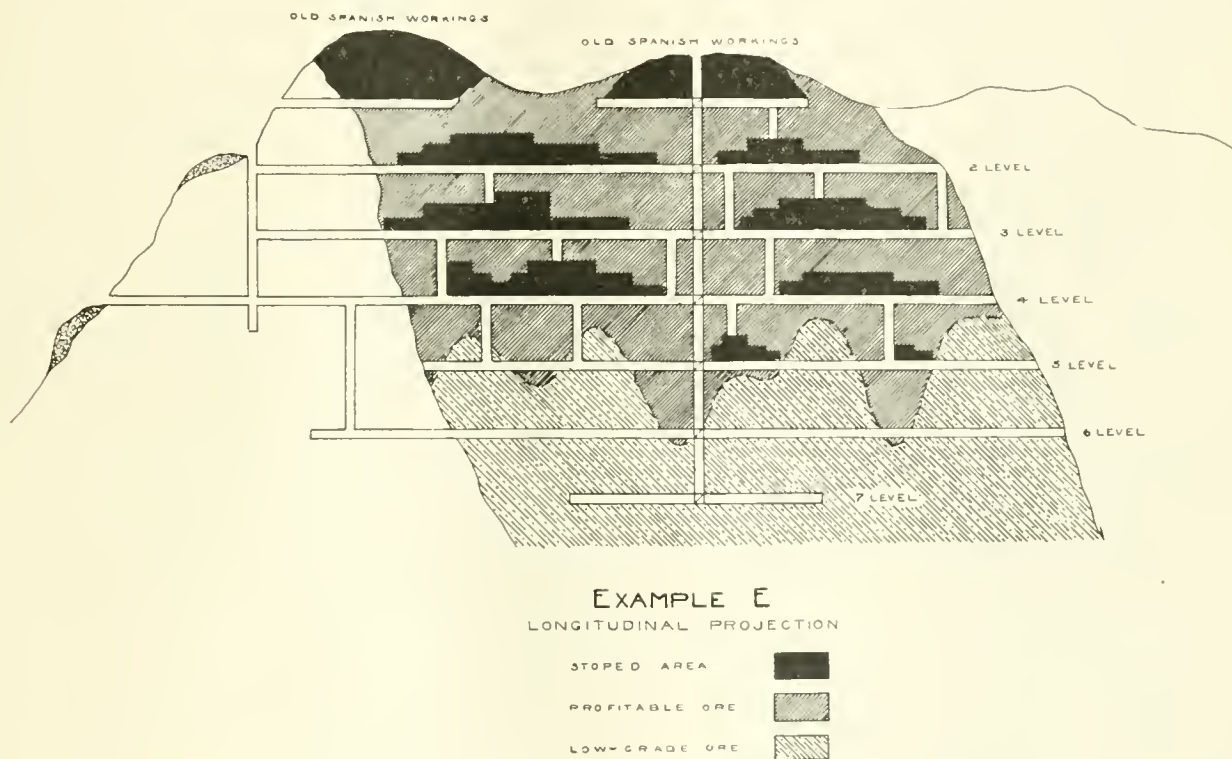
*To apply these factors to other cases it should be understood that they were devised to meet a case of recurring ore-shoots. They would not apply to a single-shoot mine or a mine depending on a limited number of large shoots. The depth and experience of adjoining operations would be a natural corollary to factor No. 7 had this not been the only mine in the district.

would demand a large cash payment with the remainder, in short order.

Example D is a mine that was financially in strong hands. The ore-reserve was developed to a maximum in order to permit the erection of a smelter. Everything was done to get the mine in the best possible shape and the ore produced during exploration was stacked on the surface. The expense of development was met out of capital account. Development was extremely favorable down to the 500-ft. level. Assuming that the mine was offered for sale coincident with the completion of this level, and before the 600-ft. level was installed, the owner would have asked a large price for the future possibilities. This probably would have been granted, for the property would be unique in its well-found condition in

in the proportion of pyrrhotite and non-cuprous primary iron pyrite. These minerals continued to displace the copper minerals in direct proportion with depth. There was no falling off in the length or width of the M shoot with depth, but it was probable that on the 1000-ft. horizon it would not assay more than 1.75% copper.

The moral of this example is the importance of factor No. 7 referred to in example C. The deposit in its primary state was not profitable in contradiction to example C. The falling off in copper content conformed to the irregular line X Y. The H ore-shoot was of excellent grade right down to its bottom tip as disclosed by the 600-ft. level. The non-cuprous 'white iron' condition commenced to come in on the eastern extremity of the N ore-shoot. The unfortunate change in copper tenor was



comparison with the usual state of a mine that comes on the market.

An unfortunate change in the copper content occurred in the eastern extension of the 600-ft. level. While the orebody remained of the same width as above, the assay dropped from 5.5% copper to about 3.75%. Where the level was extended into shoot N the grade declined from about 6% copper, the average of the 300-ft. and 400-ft. levels in this shoot, to about 4%. When the 700-ft. level was completed the average assay was found to be only about 3.25% in the M shoot. A new orebody of important width was picked up by the easterly extension of this level. This was either a separate shoot or a tongue from the M shoot. While this orebody was of important width and had indications of permanence, it only assayed 2.5% copper. The sampling of the 800-ft. level was 2.25% for the M shoot and 1.75% for the R shoot. This, roughly, was a drop of 50% in the copper content in 300 ft. from the 500-ft. level, the best level in the mine.

The reason for this change was evidently an increase

only partly due to the termination of secondary enrichment. The line X Y is probably coincident with the temperature line where the ascending copper minerals commenced to precipitate.

Example E is a gold mine in Central America. It is presented to show that the ore-reserve of a mine and its future beyond exposures are unconnected propositions is equally true of gold mines. The example is typical of a geological condition that is the cause of the superficial nature of most gold deposits. Their high mortality is due to the intersection of the zone of oxidation with the primary ore. The oxidized areas are rendered profitable owing to an enrichment by differential leaching, leaving the precious metal in greater proportion to the original mass. In such cases, when development penetrates into the unaltered primary ore the radical reduction in gold content renders the mine unprofitable. The great majority of gold mines that are profitable below oxidation owe their existence to the association of the gold with iron pyrite or other base minerals.

I was employed by a British company to examine this mine with a view to advising as to the erection of a larger mill. The local management had advised that the mine as a whole assayed about \$8.50 over a width of 7.5 ft. They recommended quadrupling the capacity of the mill. The intention was to increase the output, so that the spread in standing charges would permit a profit.

At the date of my examination, the No. 5 level had been completed. On sampling the mine, my results were \$8.75 over a width of 6 ft. from No. 2 level to No. 4 level inclusive. I was fortunate in observing a significant change in four different parts of the No. 5 level. On levels No. 2 to No. 4 inclusive the gold content was associated with a highly hydrated gangue. On the No. 5 level hard unoxidized tongues of white (bull) quartz came in. The assay of the white quartz never averaged over \$4.50 per ton. This evidence made me cautious about recommending mill enlargement. I advised that No. 6 level be driven and that the situation be reviewed in the light of this additional evidence.

The longitudinal projection indicates the workings after this level was completed. No. 6 level was very disappointing. At two points oxidation extended down to the level, where good assays were obtained, but as a whole the level was unprofitable. The sampling of No. 7 level averaged about \$4 per ton.

The reason the true state of the mine was not detected prior to my examination was probably because the tongues of unaltered quartz came into the No. 5 level in four separate places, and as this was the lowest level the significant connection between the white quartz and the drop in assay was unnoticed by the local management.

The development of gutted mines must pass through the same phases of risk as closed or inaccessible mines discussed in my preceding article. These risks, progressing in the sequence of an anti-climax, were called, Initial, Intermediate, and Mine risk. The last presupposes normality: a state of healthy balance between ore-reserves and output. The initial risk, however, is less than with closed mines, for the workings are exposed and there are more data on which to form an opinion.

Dredging in the Klondike

Since the famous placer fields of Bonanza, Eldorado, and Hunker creeks have been practically dredged out, the largest remaining dredging operations in the Klondike, that is, within a radius of 50 miles of Dawson, are those of the North West Corporation and the Canadian Klondyke Co., controlled by the Granville Mining Co., which holds most of the stock of the two operating companies.

The North West Corporation operates in the Indian River watershed, whereas the work of the Canadian Klondyke Co. is confined to the Klondike valley. Both are supplied with power from the large hydro-electric plant of the Canadian Klondyke Power Co., situated at Glenboyle, 25 miles from Dawson, where power is generated with water from the Klondike.

The North West Corporation owns two large dredges,

one of the Marion and the other of the Bucyrus type. Each has buckets of 7½ cu. ft. capacity, capable of handling 1000 cu. yd. daily. No. 1 dredge was installed during the early part of 1920 on upper Dominion creek, and began operations there last summer. It formerly was operated on the old Bear concession, and later on upper Hunker creek, by the Canadian Klondyke Co., and was the pioneer modern dredge of the Klondike. In its operations last summer, after being moved to Dominion, it met with decided success, and the outlook is considered promising, as Dominion is one of the best of the old placer creeks.

The second dredge of the North West Corporation was bought during the year from the Yukon Gold Co., and is being moved by sleighs from a point 60 miles below Hunker, where the Yukon Gold Co. finished dredging its Hunker Creek holdings, to Granville, on lower Dominion creek, where it will be assembled this year. It is the intention of the company to start operations there with the dredge as early as possible this season. The company has been preparing ground in that locality by stripping the overburden with hydraulics and by ground-slucing.

The Canadian Klondyke Co. has three huge Marion dredges, the largest in the entire North, ranking among the largest gold-dredges in the world. They are situated on the Boyle concession, which extends the full width of the Klondike valley, and from the mouth of Bonanza creek to near the mouth of Hunker creek, for a distance of some eight miles. A large portion of this wonderful deposit of auriferous gravel has been turned over by the dredges of the company during recent years, but the greater part of the concession is yet unworked, and it is estimated that 20 years will be required to work it out with the large dredge now there. Two of the dredges were working during the season of 1920, turning over a large yardage. The third dredge was idle, not having been fully equipped with buckets and other parts, which were scarce and difficult to obtain during the War. These large dredges have 17½-cu. ft. buckets, and the daily capacity of each is 10,000 to 16,000 cubic yards.

The Canadian Klondyke Power Co.'s plant has two 3000-kva. generators with a total capacity of 8000 hp., and has been generating about 3000 hp. during the summer. The North West and the Canadian Klondyke companies employ about 250 men in the busy season of the year, and about 75 during the winter. Repair work is done at a fine, large, and fully equipped machine-shop, at the mouth of Bear creek, eight miles from Dawson.

The North West Corporation has extensive placer holdings on Dominion creek, Indian river, Quartz creek, and Sulphur creek. It owns most of lower Sulphur. The dredging ground of that company and others on Sulphur creek is estimated to be 15 miles in extent, and ground on Dominion suitable for dredging likewise is estimated at 15 miles. Quartz creek has a mile and a half of dredging ground, and Indian river, for 20 miles, is supposed to contain much ground which under modern methods will prove suitable for dredging. F. P. Burrall is manager for the two companies.

Cottrell Processes of Electrical Precipitation

By the Technical Staff of the Western Precipitation Company

The smoke, fume, and dust arising in the metallurgical, cement, chemical, and other industries present a problem to be considered both from the standpoint of a civic nuisance and from that of an economic conservation. This problem has been growing steadily in importance, occasioned by the increasing seriousness of the pollution of the atmosphere, with consequent hygienic and economic damage; and through the demand for greater economy in industrial processes. In many localities, dust and fume from industrial plants constitute a nuisance, causing damage to surrounding properties, and frequently leading to expensive and prolonged litigation.

A large portion of the total losses in many industrial processes is represented by the value of dust and fume escaping from the stacks; and it is becoming more and more important from an economic standpoint to eliminate these losses by removing the suspended particles from the gases, and collecting the dust. Many possibilities are also offered for improving industrial processes, when gases can be effectively cleaned of the suspended particles. The Cottrell processes of electrical precipitation afford an efficient and economical method for the collection of liquid and solid particles suspended in air or other gases. As they are capable of treating gases of wide ranges of temperature and various characteristics, the processes are applicable to a great variety of industrial problems. They are now generally considered as standard methods in the metallurgical, cement, chemical, and other industries, where the elimination of the dust nuisance or the recovery of a valuable product from the collected material have become important factors for consideration.

The removal of suspended particles from gases by means of electrical discharges was first suggested, so far as known, as early as 1824 by Hohlfeld, a teacher in the Thomas school at Leipzig, Germany. He found that if he electrified a wire hung in a bottle filled with smoke, the smoke cleared rapidly, and a deposit formed on the sides and bottom of the bottle. About 25 years later, this phenomenon was again called to public notice by C. F. Guitard, of London. His suggestion did not seem to stimulate any practical application of the principle, and apparently the subject was forgotten. Sir Oliver Lodge again brought up the subject of electrical precipitation in a series of articles appearing in 1884, 1885, and 1886. He had independently discovered the same phenomenon as the early investigators, and advocated the use of electrical precipitation for the abatement of smoke and the dissipation of fog.

The first recorded attempts of the commercial application of electrical precipitation were made at the Dee Bank Lead Works in Wales, in 1885. These experiments

were conducted by A. O. Walker and W. M. Hutchings, with the co-operation of Sir Oliver Lodge. The apparatus as constructed did not prove equal to the requirements of commercial practice, and the work was abandoned. However, this work led to the first patents on the process in England and other countries during the years 1884 to 1886, but these have long since expired. During the same period, and quite independently, Dr. Karl Moeller, of Brackwede, Germany, experimented with the electrical precipitation of dust and fume, and obtained a

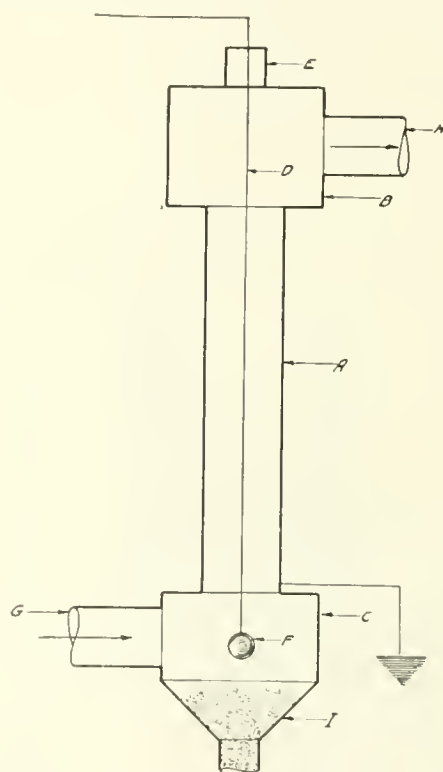


FIG. 1. SCHEMATIC ILLUSTRATION OF THE OPERATION OF A COTTRELL PRECIPITATOR

patent in Germany in 1884. No commercial application, however, was made of his method. During the 20 years following, an occasional article called attention to the possibilities of electrical precipitation, and a few patents on details and modifications were issued, but no permanent commercial installation resulted.

In 1906, Dr. F. G. Cottrell, recently director of the Bureau of Mines, who was then professor of physical chemistry in the University of California, had occasion to repeat the early experiments of Lodge, while studying the removal of acid mists in the contact sulphuric acid process. He became convinced of the possibilities of commercial application of electrical precipitation; and tests made at the Hercules works of the Du Pont de

Nemours Co. at Pinole, California, in 1906, demonstrated this fact conclusively. The first commercial installation of the process was made at the plant of the Selby Smelting & Lead Co., on San Francisco bay, for the collection of sulphuric acid fumes arising from purging kettles. The Western Precipitation Co. and the International Precipitation Co. were organized in 1907 for the purpose

pose. This organization, the Research Corporation, with headquarters in New York City, is now actively engaged in this work.

THEORY AND PRINCIPLES. The electrical precipitation of suspended particles from gases is accomplished by passing the gases to be cleaned through a high potential unidirectional electrical field, between two oppositely charged electrodes, one of small area, called the discharge electrode, and the other of larger area, called the collecting electrode. The collecting electrode is grounded, whereas the discharge electrode is insulated from it, and is connected to a source of high-potential unidirectional electricity. During the process of treatment, the individual suspended particles are electrically charged, and are driven by the force of the electric field toward the collecting electrode and are deposited thereon. The cleaned gases then pass on through the apparatus unaffected.

The operation of the Cottrell precipitator is illustrated schematically in Fig. 1. The pipe *A*, or collecting electrode, terminates in headers *B* and *C*. The discharge electrode *D* is suspended axially in the pipe, and is insulated from it at *E*, and held taut by weight *F*. Gases enter from the

G and pass through pipe *A*, and when the current is on, and the precipitator in operation, the charged particles are deposited on the electrode *A*, the gases passing out through the pipe to the outlet *H*. The deposited particles are dislodged from the electrodes by means of rapping devices which deliver a sharp blow on the pipe; and the collected material falls into the lower header or hopper *I*. If of a liquid nature, the material may run down the surface of the electrodes into a sump or other suitable receiver.

In commercial practice several types of Cottrell precipitators are employed. These are usually designated according to the type of collecting electrodes used, such as pipes, plates, screens, or the like. The direction of the gas flow may be vertical or horizontal. In the vertical-flow precipitator, up or down draft may be employed. The type of precipitator to be used is determined by the nature of the

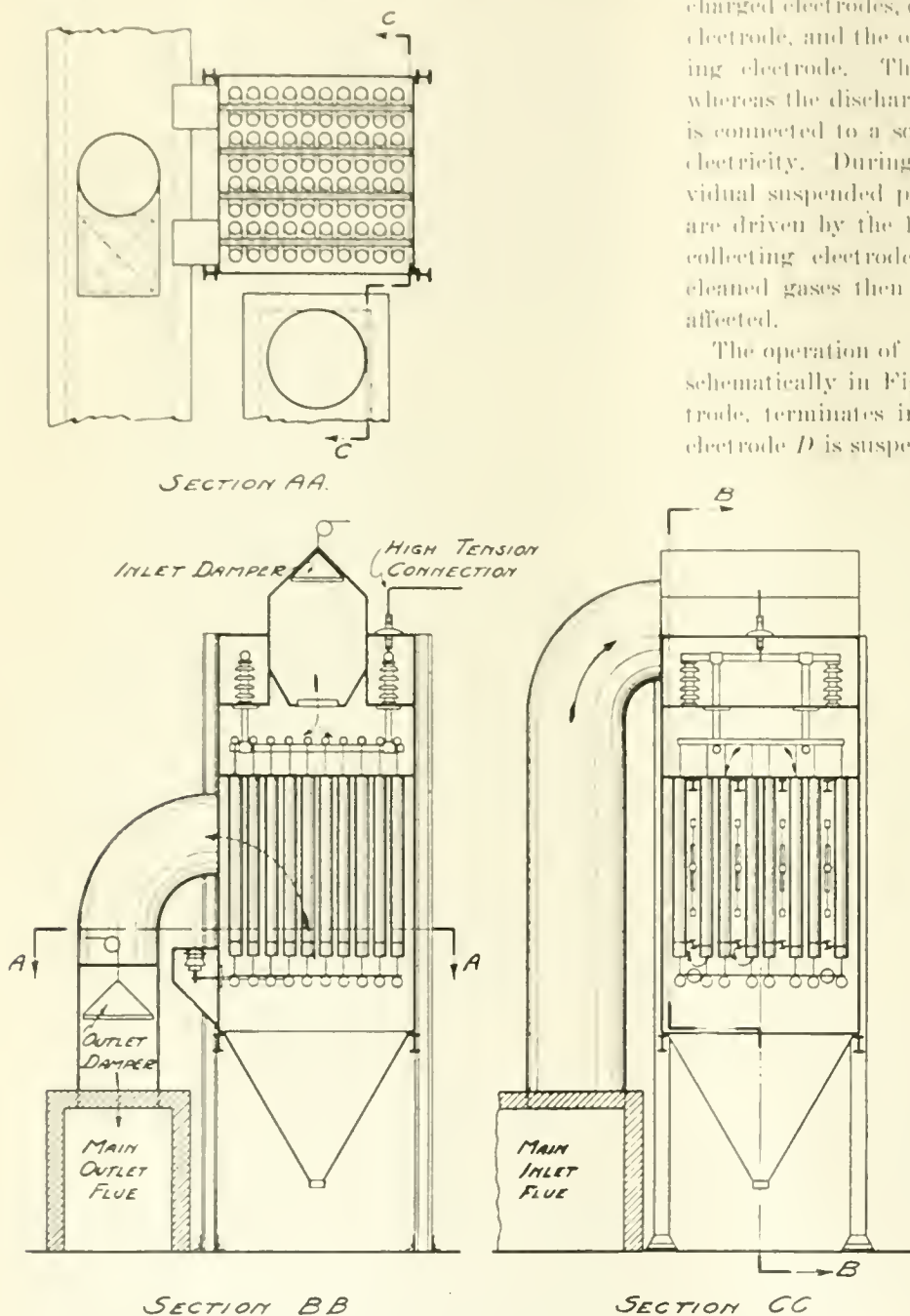


FIG. 2. SCHEMATIC DRAWING OF ONE UNIT OF A PIPE OR VERTICAL-TYPE PRECIPITATOR

of administering the patent rights of the Cottrell processes in domestic and foreign fields, respectively. In 1912, certain precipitation rights in the United States, not controlled by the Western Precipitation Co., were offered to the Smithsonian Institution. However, the Smithsonian Institution, under its charter, could not conduct the business activities which the offer entailed, and a separate organization was incorporated for this pur-

pose. This organization, the Research Corporation, with headquarters in New York City, is now actively engaged in this work.
 The direction of the gas flow may be vertical or horizontal. In the vertical-flow precipitator, up or down draft may be employed. The type of precipitator to be used is determined by the nature of the specific problem, the character and volume of the gases to be treated, nature of the dust and fume, and local conditions at the plant, such as space available. The collecting electrodes are grouped in units, which may be subdivided into sections. Fig. 2 illustrates one unit of a pipe or vertical-flow type of precipitator. Fig. 3 and 4 show two types of plate precipitator, Fig. 3 being an early type, and Fig. 4 representing a later development.

In all types of precipitators each unit is independent of the others, and may be shut-down at any time for repairs or inspection without interfering with the operation of the other units.

ing material. The collected dust which does not fall by gravity into the hopper below the precipitator, is dislodged from the electrodes by means of rapping devices which vibrate the electrode system.

ELECTRICAL EQUIPMENT. To produce high-potential charge on the discharge electrodes, a unidirectional current of high voltage is necessary. Alternating current of low voltage is stepped up to the desired voltage by means of a transformer, and then converted into unidirectional current by means of a motor-driven high-tension mechanical rectifier. A rectifier of special design has been developed for this purpose. A complete electrical unit consists of a motor-generator set, directly connected to the rectifier; a high-potential transformer capable of delivering from 50,000 to 100,000 volts; and a switchboard and instruments. The transformer voltage required depends on the spacing between the discharge and collecting electrodes, the character of the gases, the dust concentration, and various other factors. In certain cases, where power conditions at a plant are favorable, synchronous motors may be used in place of motor-generator sets, the power then being taken directly from the factory line. The number of electrical units required depends on the size of the installation.

FACTORS ENTERING INTO CONSIDERATION IN THE DESIGN OF INSTALLATIONS. The composition and the electrical conductivity of the gases, the nature of the suspended particles, the temperature, gas volume, and many other factors must be taken

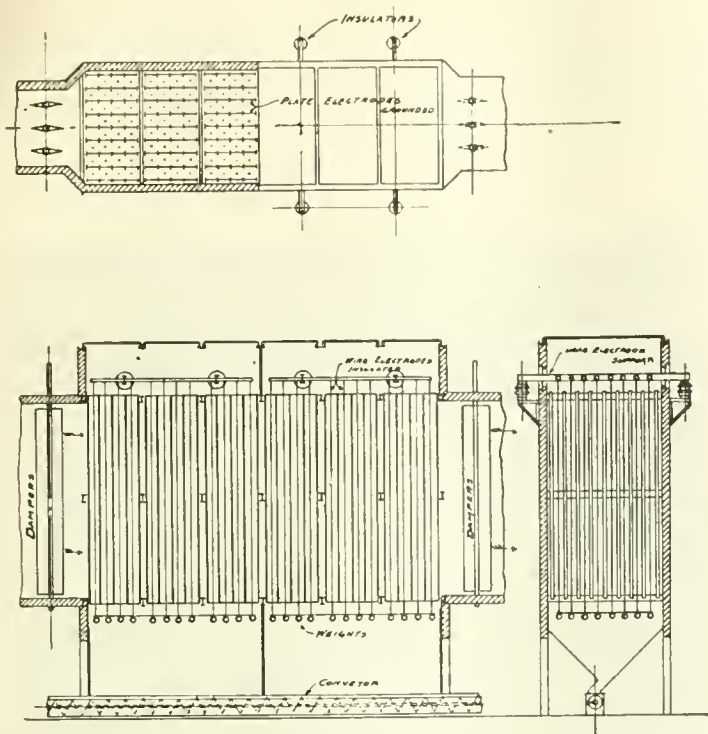


FIG. 3. SCHEMATIC DRAWING OF PLATE OR HORIZONTAL TYPE OF PRECIPITATOR. BOTH COLLECTING AND DISCHARGE ELECTRODES ARE SUSPENDED VERTICALLY.

CONSTRUCTION OF PRECIPITATORS. The pipe precipitator is usually built of steel pipes, arranged vertically in groups or units. The length and diameter of the pipes may vary in different installations, and either up or down draft may be employed. Tile, lead, or wood pipes may be used, instead of steel, especially in plants where corrosive fumes are to be treated. The plate-type of precipitator may be constructed of lead or corrugated-iron sheets, or similar material. As in the pipe precipitator, the material is dependent on the character of the gases. Screens have also been used as collecting electrodes. The discharge electrodes may consist of wires, chains, or rods, acid-resisting materials being used in the case of corrosive gases. The precipitator building may be constructed of any suitable build-

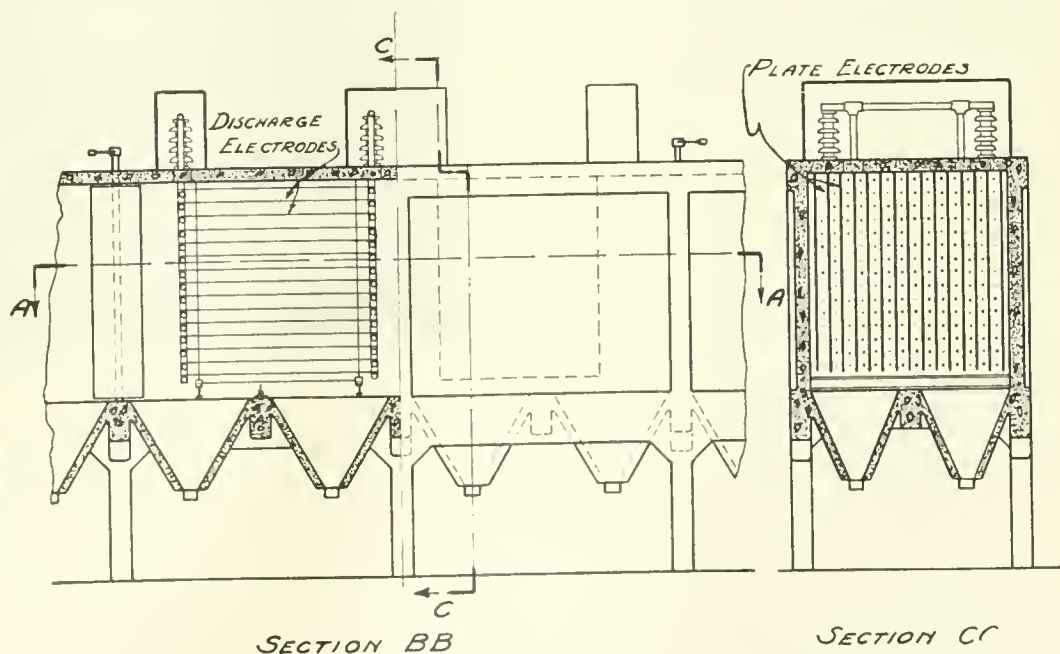


FIG. 4. TYPE OF PRECIPITATOR WITH COLLECTING ELECTRODES SUSPENDED VERTICALLY AND DISCHARGE ELECTRODES ARRANGED HORIZONTALLY

into consideration when designing a plant to handle a specific problem. The presence of acids or other corrosive substances in the gases, for instance, determines the material to be used in the construction of the precipitator, as well as the type of electrodes to be em-

played. Different gases have different electrical characteristics, and precipitation is influenced both by the nature and temperature of the gases, and the nature and condition of the deposited dust and fume. Humidification is occasionally necessary to secure proper conditioning of the gases for efficient precipitation, and conducting materials may be added to the fume, in order to secure proper conductivity. The separation from the gases of substances having different volatilization or condensation temperatures may be effected by the use of fractional precipitation; that is, by using precipitators in series, and treating the gases at different temperatures. The collection of arsenic tri-oxide from copper-bearing flue-dust is an example of fractional precipitation. The gases are passed through one precipitator at 800° F., the dust being precipitated while the arsenic tri-oxide vapors pass on through cooling flues to a cold precipitator, where the arsenic is collected in a highly concentrated form.

RECOVERY AND EFFICIENCY. Precipitation is influenced by many variable characteristics of the gases, such as temperature, velocity, volume, acidity, or humidity; and these in turn may be influenced by such factors as fluctuations in furnace operations, infiltrations of air, or other causes. As a consequence of these variations, the operation of the precipitator is also affected, and the efficiency of collection may vary to a certain degree; but in most cases the efficiency is found to remain practically uniform. A few examples will serve to show the average recovery and efficiency obtained at various plants: At a plant where gases from Wedge roasters, operating on copper ore and flotation concentrates, are treated, seven tons of dust is collected per roaster daily, the dust containing from 6 to 7% copper. The efficiency of collection averages 97%. An installation treating the gases from three copper converters collects about 2½ tons of dust per day, averaging 35% copper. The efficiency, figured on the copper collection, is about 98%. At a cement plant equipped with kilns 8 ft. by 125 ft. in size, 15 tons of dust is being collected per kiln every 24 hours. The efficiency averages about 98%. A leaching-plant has been installed for the treatment of the collected dust, at another cement plant; and mixed muriate and sulphate of potash salts are being produced. These potash salts find a ready demand in the fertilizer market. A precipitator installed during the War in a British sulphuric-acid plant, where gases from 16 Gaillard concentrators were treated, collected about 25 tons of a 50% acid per day. This installation not only proved profitable, but eliminated the fume problem and improved the conditions in the plant and its vicinity.

APPLICATION OF THE PROCESS. The Cottrell process has been applied successfully to a great variety of industrial problems, in the metallurgical, cement, chemical, and other industries, and new uses are constantly being developed. The wide range of possibilities of applica-

tion is illustrated in the following incomplete list: Collection of dust and fumes, and recovery of material of value from gases produced by lead and copper blast-furnaces, sintering machines, roasters, reverberatory smelting and refining furnaces, lead and copper converters, nodulizing, roasting, and calcining kilns; cleaning gases from iron blast furnaces for use in boilers and stoves, and recovery of potash from the dust; collection of fume produced during the chloridizing volatilization of ore and tailing, and recovery of valuable material; cleaning gases from furnaces operating on cinnabar ores;

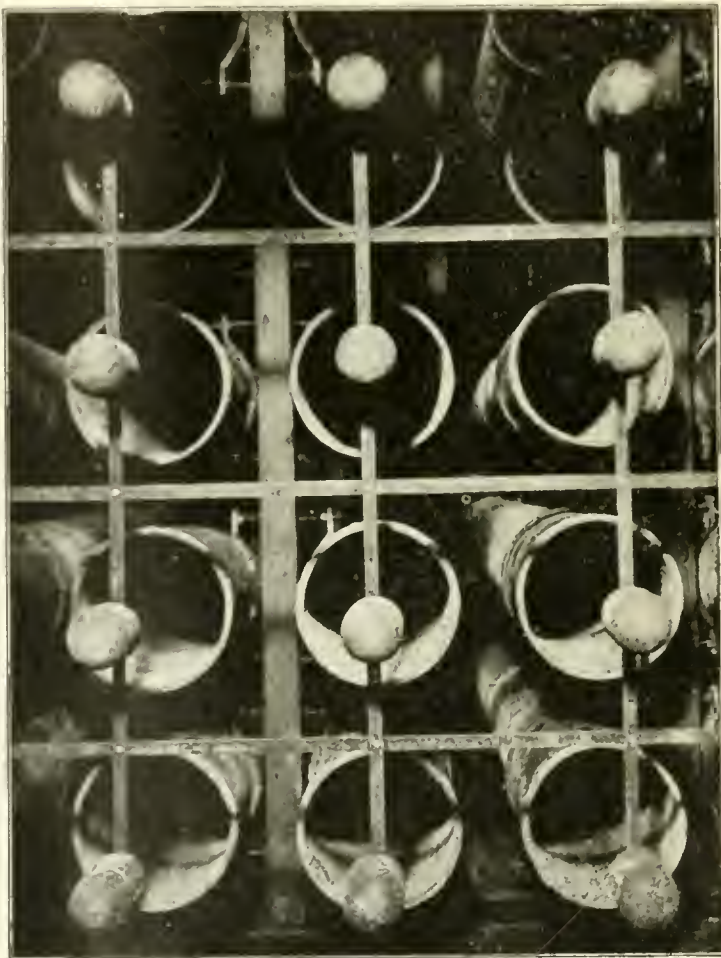


FIG. 5. LOWER END OF PIPE PRECIPITATOR, LOOKING UPWARD. LOWER GRID AND DISCHARGE-ELECTRODE TENSIONING-WEIGHTS ARE SHOWN.

cleaning hot gases from furnaces roasting pyrites, zinc-sulphide ores, etc., in sulphuric-acid plants; collection of dust and recovery of potash from cement-kiln gases; recovery of soda salts from waste-liquor evaporator gases in sulphate-pulp mills; removal of acid mists from gases of sulphuric-acid concentrators, or gases produced during nitrating operations; cleaning gases from electric furnaces producing calcium carbide and ferro-silicon; removal of lampblack, tar, and naphthalene from exit-gases of briquetting plants of gas and coke works; cleaning coke oven, illuminating and producer gas, and recovering tar and oils; removal of chlorine gas from air containing a small percentage of this gas, by absorption

in a cloud of suspended material introduced into the gases, and precipitation of this material; collection of dried milk and fruit powders when manufactured by spray-drying processes.

BIBLIOGRAPHY

- 1824—HOHLFELD, M. Das Niederschlagen der Rauchs durch Elektrizität. *Archive für die Gesamte Naturlehre*, Vol. 2, p. 200.
- 1850—GUITARD, C. F. Condensation by Electricity. *Mechanics' Magazine*, Vol. 53, p. 346.
- 1885—WALKER, A. O. A New Application of Electricity. *Engineering* (London), Vol. 39, p. 627. See also *Scientific American Supplement* (June 27).
- 1886—LODGE, SIR OLIVER. The Electrical Deposition of Dust and Smoke with Special Reference to the Collection of Metallic Fumes. *Jour. Soc. of Chem. Ind.*, Vol. 5, p. 572.
- 1896—ILES, M. W. Methods for the Collection of Metallurgic Dust and Fume. *School of Mines Quarterly*, Vol. 17, p. 109.
- 1908—ANON. Cottrell Process for Condensing Smelter Fume. *E. & M. J.*, Vol. 86, p. 375 (August 22). See also *Electrochem. & Met. Ind.*, Vol. 6, p. 421 (October).
- 1911—COTTRELL, F. G. The Electrical Precipitation of Suspended Particles. *Jour. of Ind. & Eng. Chem.*, Vol. 3, p. 542 (August). See also *E. & M. J.*, Vol. 92, p. 763 (October 14); *M. & S. P.*, Vol. 103, p. 255 (August 26).
- 1912—COTTRELL, F. G. Electrical Fume Precipitation. *Trans. A. I. M. E.*, Vol. 43, pp. 512, 755. See also *Met. & Chem. Eng.*, Vol. 10, p. 172 (March).
- SCHMIDT, W. A. The Control of Dust in Portland Cement Manufacture. *Eighth International Congress of Applied Chemistry*, Vol. 5, p. 117. See also *Met. & Chem. Eng.*, Vol. 10, pp. 99, 611 (September 12).
- BRADLEY, LINN. Electrical Precipitation of Suspended Particles. *Eighth International Congress of Applied Chemistry*, Vol. 26, p. 471 (September). See also *Trans. Amer. Electrochem. Soc.*, Vol. 22; *Met. & Chem. Eng.*, Vol. 10, p. 629 (September 22); *Jour. Ind. & Eng. Chem.*, Vol. 4, p. 908 (December).
- WHITE, A. H.; HACKER, J. W.; STEERE, F. The Electrical Separation of Tar from Coal Gas. *Amer. Gas Light Jour.*, Vol. 97, p. 210 (September 30).
- 1913—HOLMES, H. N. Precipitation of Smoke and Suspended Dust by Electrostatic Method. *Electrical World*, Vol. 61, p. 401 (February 22).
- 1914—TAYLOR, P. S. Electrical Precipitation of Cement Dust. *Jour. Elec. Power & Gas* (March 14).
- ANON. The Research Corporation and the Cottrell Process. *E. & M. J.*, Vol. 97, p. 1107 (May 30).
- HOWARD, W. H. Fume Precipitation at Garfield. *Trans. A. I. M. E.*, Vol. 49, p. 540.
- WHITE, A. H.; ROWLEY, R. B.; WIRTH, C. K. Electrical Separation of Tar from Coal Gas. *Am. Gas Light Jour.*, Vol. 101, p. 177.
- COTTRELL, F. G. Problems in Smoke, Fume and Dust Abatement. *Smithsonian Institution Report for 1913*; Pub. 2307, pp. 653-685.
- EDITORIAL. Progress of Electrical Precipitation. *M. & S. P.*, Vol. 109, p. 626 (October 24).
- DUNN, E. M. Electrostatic Fume Precipitation at Anaconda. *Trans. A. I. M. E.*, Vol. 49, p. 557.
- 1915—STEWART, R. H. Improvements at the Trail Smelter, British Columbia. *M. & S. P.*, Vol. 110, p. 74 (January 9).
- STRONG, W. W.; NESBIT, A. F.; BRADLEY, LINN. Papers on Electrical Precipitation. *Proc. A. I. E. E.*, Vol. 34, pp. 229, 507, 523.
- SCHMIDT, W. A. Cottrell Process of Electrical Precipitation. *Trans. A. I. C. E.*, Vol. 8, p. 35. See also *Trans. Can. Min. Inst.*, Vol. 18, p. 110.
- ALDRICH, C. H. Treatment of Silver Furnace Fume by the Cottrell Process. *Trans. Amer. Electrochem. Soc.*, Vol. 28, p. 119. See also *Min. & Eng. World* (December 11).
- BRADLEY, LINN. Solution of Smoke, Fume and Dust Problems by Electrical Precipitation. *Met. & Chem. Eng.*, Vol. 13, p. 911 (December 1).
- 1916—COTTRELL, F. G. Recent Progress in Electrical Smoke Precipitation. *E. & M. J.*, Vol. 101, p. 385 (February 26).
- KERNS, R. W. International Smelter at Miami. *E. & M. J.*, Vol. 101, p. 421 (March 24). See also *Electrical Precipitation. Electric Journal*, p. 575 (December).
- CATLETT, CHARLES. The Blast Furnace as a Potash Producer. *Manufacturers' Record*, Vol. 69, p. 41 (May 11).
- RICKETTS, L. D. Dust Losses in Copper Smelting. *E. & M. J.*, Vol. 102, p. 396 (August 26).
- HEWITT, A. C. Potash Becomes a Valuable Cement Mill By-product. *Eng. News*, Vol. 76, p. 1222 (December 28).
- 1917—BRADLEY, LINN. The Cottrell Process in Practice. *Met. & Chem. Eng.*, Vol. 16, p. 336 (March 15).
- WYSOR, R. J. Potash as a By-product of the Blast Furnace. *Trans. A. I. M. E.*, Vol. 56, p. 257. See also *Met. & Chem. Eng.*, Vol. 16, p. 205 (February 15).
- ROSS, W. H.; CAROTHERS, J. N.; MERZ, A. R. Electric Furnace Smelting of Phosphate Rock and Use of the Cottrell Precipitator in Collecting the Volatilized Phosphoric Acid. *Jour. Ind. & Eng. Chem.*, Vol. 9, p. 26.
- BRADLEY, LINN; EGBERT, H. D.; STRONG, W. W. Dry-Hot versus Cold-Wet Blast Furnace Gas Cleaning. *Trans. A. I. M. E.*, Vol. 56, pp. 303, 319, 337. See also *Met. & Chem. Eng.*, Vol. 16, p. 283 (March 1).
- MESTON, A. F. Electrical Precipitation in the

- Chemical Industries. Elec. Jour., p. 248 (June).
- NASTILL, R. J.; ANDERSON, E. The Nature of Cement Mill Potash. Jour. Ind. & Eng. Chem., Vol. 9, p. 646 (July).
- RAILSTON, O. C.; WILLIAMS, C. E.; FRY, M. J.; HOYT, G. J. Salt in the Metallurgy of Lead. Trans. A. I. M. E., Vol. 57, p. 631.
- PORTER, J. J. Recovery of Potash as By-product in Manufacture of Portland Cement. Concrete, Vol. 11, p. 27 (October). See also Manufacturers' Record (October).
- ROSS, W. H.; MERZ, A. R.; WAGNER, C. R. The Recovery of Potash as a By-product in the Cement Industry. U. S. Department of Agriculture Bull. No. 572. See also American Fertilizer, p. 35 (January 191).
- 1918—CROTHERS, J. N. Electric Furnace Smelting of Phosphate Rock and Use of the Cottrell Precipitator in Collecting the Volatilized Phosphoric Acid. Jour. Ind. & Eng. Chem., Vol. 10, p. 35 (January).
- WATSON, R. A. The Humboldt Roasting Plant. M. & S. P., Vol. 116, p. 335 (March 9).
- BROWN, D. M. New Fume Treatment Plant at Anaconda. M. & S. P., Vol. 116, p. 895 (June 20).
- RIDDELL, G. C. Ideal Layout for Silver-Lead Smeltery. E. & M. J., Vol. 106, p. 115 (July 20).
- ESCHOLZ, O. H. Electrostatic Precipitation. Trans. A. I. M. E., Vol. 60, p. 243.
- DUSCHAK, L. H.; SCHUETTE, C. N. Condensing Quicksilver from Furnace Gases. M. & S. P., Vol. 117, p. 315 (September 7).
- HEIMROD, A. A. The Cottrell Processes in the Sulphuric Acid Industry. Chem. & Met. Eng., Vol. 19, p. 309 (September 15).
- BRADLEY, LINN. The Cottrell Process for Potash Recovery. Chem. & Met. Eng., Vol. 19, p. 457 (September 26). See also Jour. Ind. & Eng. Chem., Vol. 10, p. 834 (October); American Fertilizer, p. 58 (October 12).
- EGBERT, H. D. Application of the Cottrell Process to Foundry Dust Problems. Iron Trade Review (October 24).
- BUSH, H. J. Cottrell Electrostatic Recovery Process. Jour. Soc. Chem. Ind., Vol. 37, p. 389 (October 31).
- RICE, C. T. Lead Refining at the Bunker Hill Plant. E. & M. J., Vol. 106, p. 771 (November 2).
- SUTHERLAND, W. F. Canada Controls Nickel Output of the World. Can. Mach., Vol. 20, p. 733 (December 26). See also International Nickel Refinery. E. & M. J., Vol. 107, p. 429 (March 8).
- EASTON, W. H. Electrostatic Dust Precipitation. Ind. Management, p. 473 (December).
- 1919—THUM, E. E. Notes on Electrical Precipitators. Chem. & Met. Eng., Vol. 20, p. 59 (January 15).
- BRADY, H. D. Notes on Electrostatic Precipitation. Chem. & Met. Eng., Vol. 20, p. 384 (April 15). See also Trans. Amer. Electrochem. Soc., Vol. 35, p. 199.
- WACHORN, J. M. Electrical Precipitation of Solids from Flue Gases. Eng. World, Vol. 14, p. 39 (May 16).
- EDITORIAL. Clinchfield Portland Cement Corporation. Chem. & Met. Eng., Vol. 20, p. 569 (June 1).
- GILBERT, H. N. Electrical Cleaning of Blast Furnace Gas. Blast Furnace & Steel Plant (July). See also American Fertilizer, p. 61 (September 13).
- SMITH, W. G.; HEIMROD, A. A. Application of the Cottrell Process to the Recovery of Fume from Silver Refining Operations. Chem. & Met. Eng., Vol. 21, p. 360 (September 15).
- VARELY, T.; MOSES, F. G. Chloride Volatilization and the Cottrell Process. Bull. No. 9, University of Utah (September).
- EDITORIAL. Electrical Equipment Used in Precipitation of Material from Smoke and Gases. Elec. Rec., p. 304 (November).
- HIROTA, R.; SINGA, K. Cottrell Electrical Precipitation Processes in Japan. E. & M. J., Vol. 108, p. 895 (December 20). See also Chem. & Met. Eng., Vol. 22, p. 276 (February 11).
- 1920—YOUNG, A. B. Tooele Flue-type Cottrell Treater. Mining & Metallurgy (Bull. A. I. M. & M. E.), p. 31 (June). See also M. & S. P., Vol. 121, p. 273 (August 21).
- ANON. Successful Potash Recovery at Cement Plant. Rock Products, Vol. 23, p. 17 (August 28).

From a financial point of view there were three periods in the Russian Maritime Province during the year 1920, states a consular report. (1) The period of circulation of Vladivostok rubles. At the beginning of the year the rate of this ruble was 160 per yen, the rate steadily increasing until the middle of June, when it reached 3000 per yen. The Siberian government then decreed that one new ruble was equal to 200 Siberian rubles. This effort at financial reform was met with hostility by foreigners, who refused to accept the rubles and went on a strike by closing their shops. The larger Russian merchants, also, were antagonistic. (2) The period of new or 'buffer rubles'. The foreigners and the large Russian merchants began a campaign that succeeded in lowering the rate of exchange of the new rubles, 10 of which had been decreed to equal 1 yen. (3) The period of silver-coin issue. In October, when the Siberian government issued small silver coins, a considerable part of them was bought at 3½ to 4 rubles per yen and shipped abroad for melting. From the moment of issue of these silver coins the buffer rubles practically disappeared from circulation. The ruble is a Russian coin; the yen, Japanese. Both are worth, in normal times, about 50 cents.

Reconstruction in Mexico

By An Occasional Correspondent

Since my last letter was published in the 'Press' of September 4, 1920, not only has much water gone over Necaxa but much smoke has issued from 'Popo'; both of which happenings have been of serious import for the inhabitants of the ancient capital of Moctezuma. Owing to the scarcity of rain last year the reservoirs of the great Canadian hydro-electric plant, at Necaxa falls, 100 miles from the capital and on the eastern edge of the central plateau, were only partly filled, and, in consequence, many towns dependent on this source of supply are facing a lack of light and power. On February 20, the City of Mexico adopted daylight-saving by setting all clocks an hour ahead of solar time, and issued stringent closing regulations, affecting all consumers of light and power, with the hope of avoiding the complete shut-down of the Necaxa service. This calamity would have been inevitable in the event of a late rainy season, which sometimes starts in May but often not until July. With the increase of population that has occurred since 1915 in the Federal district, owing to the concentration there of the upper classes who found it unsafe to live in their rural homes during the regime of Carranza, the demand for electric current from Necaxa has increased considerably, and the present shortage is sure to recur after every dry year. As the further utilization of power from the Necaxa water, by extending the pipes downhill from the present tailrace, would require an additional investment, it might prove cheaper to connect with the electric system of Puebla City, by extending the transmission lines some 60 miles to the south. At Orizaba, only 140 miles by air-line south-east from Mexico City, the Puebla company possesses a large surplus of cheaply-developed water-power already connected by wire with its home plant.

For many years the great volcano of Popocatepetl, the snow-capped cone that rises to an altitude of over 17,000 ft. between the valleys of Mexico City and of Puebla, had given no signs of life and was popularly supposed to be extinct. But last summer the monster began to wake up, and at present a regular eruption is in progress, accompanied by quantities of smoke and ashes, the melting of the snow-cap, and the opening of new vents in the crater walls. The Indians who occupied the villages around the peak have fled in terror to safer homes, and everyone is wondering what will happen next.

The steady drop in the price of silver last autumn affected a great number of Mexican mines; at Pachuca many companies, notably the La Blanca, the Maravillas, and the Purísima, ceased operations during November, throwing about 5000 men out of work. The La Blanca mine started again in January, but owing to the curtailment of the electric service of Necaxa (which also sup-

plies Pachuca) this mine, as well as the other bigger ones, the Real del Monte, Santa Gertrudis, and San Rafael, which did not shut-down, have been obliged to curtail their outputs. After three years of unexampled prosperity and wonderful dividends, the Pates have turned against the Pachuca mines and they are evidently scheduled for a run of ill luck.

In December the tailing-dam of the Maravillas mill gave way and precipitated a flood of poisoned water and slime down the gulch and into the city of Pachuca. Fortunately, only 29 persons were killed, but the indemnity that must be paid for these and the property destroyed has been estimated by an official commission to be at least \$400,000—an amount sufficient probably to throw the company into bankruptcy, as it has only a medium-sized mine of low-grade silver ore and a 300-ton cyanide plant as its principal assets. A fortnight ago the 500-ton cyanide plant of the San Rafael company, which was built in 1908, was destroyed by fire, causing a shut-down of the mines, which employed about 2500 men. Fortunately for Pachuca, many of its miners are not a homeless proletariat but Indians, who visit the town to work for only part of each year and leave their families in the villages. Hence a moderate amount of public relief has been sufficient to maintain the sufferers above the present depression.

On the first of November last the National railway system advanced its passenger and freight-rates; and this advance, combined with the uncertain service that has prevailed since 1914, greatly aggravated the difficulties of the mining companies so hard hit by the drop in price of silver. In December the Mine Owners Association petitioned the Government for a reduction of the bullion tax, which was 7%, or double the tariff under Madero, and a restoration of the freight-rates to the former scale. This petition being granted, and a general reduction of the wage-rates having been accepted by the miners, most of the suspended companies were able to resume work in January on a restricted scale. The struggle of the mine-owners for a reduction in the price of explosives, so that the cost of production could be lowered to that of 1914, had no result until this spring, when the removal of the export embargo of the United States, on March 1, was accompanied by a 20% fall in the quotation for dynamite. Although the bonanza days of the Great War are evidently a matter of past history for the producers of silver, most of the well-equipped Mexican mines can make good money with 60-cent silver, provided they are assured peace, fair taxation, and an adequate railway service.

The other day I came across a booklet entitled 'The Mexican Monetary System', which was published by the

Government in 1917 as a result of the investigation here in 1917 by Prof. E. W. Kemmerer of Princeton University, who suggested the reduction in the size of the Mexican silver peso and toston (50 centavos) by about one third, and thereby enabled Mexico to preserve the gold standard during the wonderful three years for silver just past. The Kemmerer scheme maintained low wages, taxes, and other fixed charges for the silver producer, and enabled the big ones, like Real del Monte, to make extraordinary profits. On the other hand, if the old silver coinage had remained unchanged in 1917, as some advocated, Mexico would have gone on a silver basis; and wages, since then paid in silver, would consequently have advanced in purchasing power along with the increasing price of commodities. The native wage-earners would thus have had to suffer much less hardship than they have endured under the Kemmerer plan, which, unwittingly, played entirely into the hands of the foreign stockholders of the mines.

The last three months of the provisional presidency of Adolfo de la Huerta were accompanied by a continuation of the work of pacification, and the final transformation of the bandit Villa into a peaceful ranchman, proprietor of a Durango estate. Even Cuernavaca, capital of the State of Morelos and centre of the Zapatista movement, again attracted its civilized classes, by whom it had been so long deserted, and began the work of reconstruction after six years of reversion to Aztec barbarism. The lone trails of Guerrero, Morelos, Michoacan, and other parts of the western Sierra Madre, long closed to American prospectors, commenced to swarm with eager 'gringos', who, in spite of the depression in metals, had responded to the call of the wild.

Alvaro Obregon was inaugurated with the usual legal ceremonies on December 1 and began his administration with the best wishes of the bulk of the population. The chief economic post was given to the retiring president, who became Minister of Hacienda; while General Plutarco Calles, erstwhile Governor of Sonora and once Minister of Commerce under Carranza, was given the principal political office of Minister of Gobernacion. General Antonio L. Villareal, revolutionary Governor of Nuevo Leon in 1914, remained as Minister of Fomento, as did General Benjamin Hill as Minister of War, and Cuthberto Hidalgo as sub-secretary of Foreign Relations. General Trevino was displaced as Minister of Commerce by licenciado Zubaran Campany, but engineer Ortiz-Rubio continued as Minister of Communications.

The picturesque General Salvador Alvarado, who retired to private life from the Ministry of Hacienda, carried with him a concession for an oil-pipe line from Tuxpan to Mexico City, which has long been in project but now bids fair to be realized; for a company has been organized with a capital of \$10,000,000, and work, it is expected, will soon begin on the construction, for a distance of 140 miles and a rise of 8000 feet. Falsely accused of corruption in the securing of this non-exclusive franchise from the Ministry of Commerce, Alvarado challenged his traducer, the editor of 'El Universal', to

a duel; but the latter, more modern as well as less brave than the General, scornfully declined to fight. A number of other concessions, involving the illegal and exclusive privileges for monopolizing the petroleum exploration of a whole State for a term of years, were also about to be conferred by General Trevino, as Minister of Commerce, when his sudden retirement from office at the inauguration of President Obregon prevented their delivery.

The petroleum question is still the chief international problem confronting the Mexican government. The core of the controversy is whether a nation has a right to control its own natural resources, in the public interest, or not. By the Mining Code of 1783, which was applied by King Carlos III of Spain to all his American colonies, all mineral rights were declared to be a separate property from the ownership of the surface, and their titles were reserved as inalienable national property. When Mexico became independent, in 1821, the titles to all her mineral rights passed from the Spanish crown to the new nation, and apparently have not since been legally alienated. The attempted robbery of the nation by President Gonzales in 1884, when he tried to bestow all non-metallic minerals on the surface-land owners, was evidently not consummated, as it took the form of a new legal code in place of a constitutional amendment. The new Constitution of 1917 thus merely re-affirmed the original principles of Carlos III and the later Napoleonic code in declaring all non-metallic mineral rights (including combustibles) as inalienable national property.

Like the Bourbons in 1815, the great foreign petroleum-land monopolists of Mexico have evidently learnt nothing from the experiences of war, either native or European. As the Madero revolution sounded the knell of land monopoly in Mexico, either surface or subterranean, so the Great War has made impossible the further tolerance of the unrestricted fental land privileges in civilized countries. Backward in other ways, the Mexican government is one of the first to perceive clearly the correct relation of mankind to the planet; and in taking a firm stand on this principle it will, it is hoped, ultimately receive the support of every unbiased student of the land question.

Mexico is also facing the other great economic problem, that of labor unionism. Ever since the fall of Diaz the union leaders, who control only a small part of the working population, have been humored by the various native governments for political purposes. The net result has been a big increase in wages for certain favored city unions, which increase has largely been met by the bulk of consumers in the form of increased prices for commodities. The culmination of union coddling came last autumn when the congress of railway-unions was supported in Mexico City for several months at a total cost to the Government of \$156,000. When finally shaken off the national payroll, because they were engaged in picnicking instead of working, the union leaders vowed revenge and a fortnight ago called a strike. But this time the Government, as the operator of the National

railways, which include most of the lines, took a firm stand and protected, with troops, all men who wished to continue work. In spite of some sabotage, resulting in several train-wrecks, the strike at present writing seems about over, as the mass of the workmen refused to follow their leaders and continued at their jobs.

President Obregon recently announced that he was trying to model his government after the principles of Bryce's 'American Commonwealth'. In this praiseworthy effort, however, he is confronted with two great obstacles: a corrupted judiciary and a trifling congress. In spite of drawing a salary of \$12,000 yearly, whereas their predecessors under Madero only drew \$3000, the senators and deputies of the present National Congress act, for the most part, more like a crowd of college students on a lark than a body of lawmakers entrusted with the reconstruction of a nation wrecked by ten years of civil war. As a consequence, the Government is forced to use arbitrary methods, in order to perform its public duties at all, and this condition must prevail in practice until such time as an improved system of popular education shall develop a different class of politicians to fill the legislative offices. As for the judiciary, the judges under Carranza probably reached the limit of malfeasance in office; and the hauling of the bench out of the mire as proposed by the present Government is no child's task. Fortunately, many functions performed by the courts in the United States can here be entrusted to administrative officials, so that foreign miners have thus a fair chance of getting justice under a government so well-intentioned as that of President Obregon.

Before commerce can again function normally in Mexico, the banking system, wrecked by the Revolution, must be resuscitated. The worst part of this problem involves the 24 State banks of issue whose combined coffers were officially pilfered of \$100,000,000, half by Huerta in 1914 and the remainder by Carranza in 1917. Neither the scheme proposed by Minister Alvarado, last November, nor the plan of the present Government, launched in January, recognizes the validity of the forced loan made by Huerta, as both follow the Carranza idea that the Huerta government was illegal. The repudiation of the Huerta debt to the banks will throw many of the largest ones into bankruptcy; the consequent sufferers (the bank-creditors) never assented to the Huerta loan, so they are politically guiltless. As this last fact has been publicly recognized recently by the present Minister of Finance, there is good reason to believe that justice to all the bank-creditors will ultimately be accorded by the Government.

The Carranzista plotters found it healthier, some months ago, to move their headquarters away from San Antonio, Texas; so part went to Havana, Cuba, and the rest to Guatemala. In January, General Murguia escaped from his confinement, near Mexico City, to that happy hunting-ground for brigands, the fertile State of Veracruz, and since then has been waging a guerilla warfare with what help he can get from his friends in Havana. General Felix Diaz, who preceded Murguia in Veracruz

and Oaxaca, where he fought Carranza for three years, was finally exiled last November by the Government after surrendering his troops and equipment. The Carranzista plotters in Guatemala are now being cheered by a new newspaper started for the purpose by the famous 'Rip-Rip', former editor of 'El Demócrata' in Mexico City. Rip-Rip (Rafael Martinez) is an incorrigible writer but a poor financier, so in his constant search for money he was only too glad to accept a large subsidy in 1917 to make 'El Demócrata' the organ of the German propaganda in Mexico. This attitude did not at all affect his long-standing subsidy from Carranza, for nothing pleased the latter better than to find some new way of annoying his political godfather, Woodrow Wilson.

When the prophets predicted last autumn that Obregon would never dare put his plans, for the abolition of Carranzista militarism, into practice, they quite misjudged their man. Since his inauguration, the President has mustered out the soldiers at a rate exceeding 5000 per month; and he could proceed no faster because, both for political and humane reasons, it is necessary to provide the new civilians with some means of support in the form of small farms ready for cultivation.

ASBESTOS MINING IN QUEBEC, CANADA. The shipments of asbestos from the mines and mills of the Province of Quebec during the year 1920 amounted to 177,605 tons, valued at \$14,674,572. This is the highest production ever recorded, both in quantity and value, being an increase of 30% in tonnage, and 34% in value, as compared with the previous year, when the production amounted to 135,862 tons, valued at \$10,932,289. The two following tables show a detailed comparison between the production of the two years:

Production of Asbestos, 1920

Designation of grade	Tons	Value	Shipments and sales
			Average value per ton
Crude No. 1	1,026	\$1,513,457	\$1,475.10
Crude No. 2	2,830	2,295,927	811.28
Spinning fibre	13,983	3,915,562	280.02
Shingle fibre	16,784	1,852,210	110.36
Paper stocks and others	142,982	5,097,416	35.65
Total	177,605	14,674,572	82.62
Asbestic	19,716	43,559	2.20
Total	197,321	\$14,718,131	

Production of Asbestos, 1919

Designation of grade	Tons	Value	Shipments and sales
			Average value per ton
Crude No. 1	1,103	\$1,385,627	\$1,256.74
Crude No. 2	2,991	1,850,605	618.77
Mill stock No. 1	13,764	3,057,695	222.15
Mill stock No. 2	69,868	3,704,321	53.02
Mill stock No. 3	48,136	933,941	19.40
Total	135,861	10,932,289	80.47
Asbestic	23,827	63,011	2.64
Total	159,688	\$10,995,300	
Quantity of rock mined during the year 1919			3,061,690 tons

The mill stocks have been classified according to their respective industrial uses, instead of under indefinite terms. This, of course, does not mean that all the asbestos classed under each respective designation was necessarily used for that purpose, but that the great majority was or could have been so used.

Recovery of Gold From Black Sand

By John A. Davis and John Gross

INTRODUCTION. This paper is one of a series giving the results of metallurgical tests conducted by the Alaska station of the Federal Bureau of Mines, on the recovery of gold from the black sand of placer clean ups. The data given in this report were obtained from tests on a lot of black sand from a property on St. Patrick creek, Fairbanks mining district, Territory of Alaska. This property comprises the Sagan Fraction and adjoining bench-claims, and is being operated by J. A. Lillie.

The sand had already been treated at the mine by amalgamation. A sample taken by Mr. Lillie and assayed at the station showed that the gold still remaining amounted to 11c. per pound. As this gold content was sufficiently high to justify further treatment of the sand, 770 lb. was shipped to the station for testing. The reader will note that the gold content is given in cents per pound, rather than per ton. This is in conformity with practice in the district in valuing black sand, as the quantity obtained at any one time is small, much less than one ton. The sand consisted principally of schist and quartz, with very little ilmenite and garnet; and no magnetite or sulphides. Most of the gold present was contaminated with quartz, as the free particles of gold had been removed by amalgamation at the mine.

PRELIMINARY EXAMINATION. The sand was screened on a 4-mesh screen. Careful examination and panning failed to detect any gold in a ground portion of the oversize. The undersize was sampled for assay. The weights of the different portions were as follows:

	Lb.
Oversize on 4-mesh screen, discarded.....	27
Assay sample, undersize, 4 mesh screen.....	7
For testing	736
Total original weight	770

The distribution of the gold was found to be as follows:

	Weight %	Contents %
	Sand	Gold
On 10-mesh screen.....	35.7	39.8
On 35 through 10-mesh.....	43.5	53.7
Through 35-mesh screen.....	20.8	6.5
	100.0	100.0

As the amount of fine gold was very small, it was decided that classifier concentration would give satisfactory results, and this method of treatment was employed for the entire lot.

TREATMENT AND RESULTS. The 736 lb. of sand was treated in a one-spigot classifier having a rising velocity of 54 ft. per minute. The concentrate was screened on a 6-mesh screen, the oversize going to waste and the undersize being amalgamated. The tailing was screened on a 30-mesh screen, the oversize going to waste, the undersize being concentrated on a canvas table, and the concentrate amalgamated.

The weights of the products were as follows:

Concentrate, plus 6 mesh.....	11.6
Concentrate, minus 6 mesh.....	waste 0.0
Tailing, plus 30-mesh (by difference).....	amalgamated 11.6
Canvas-concentrate.....	waste 329.4
Canvas-tailing (by difference).....	amalgamated 80.9
	waste 217.4
	736

The plus 6-mesh concentrate contained no free particles of gold, but some gold, adhering to quartz grains, was present. A jigging test of this plus 6-mesh material indicated that approximately 75% of this gold might be recovered by amalgamating the jig concentrate. This material could be jigged on a riddle in a tub of water, reserving only the heavier portion next to the screen for amalgamation, but is doubtful whether treatment would usually pay.

The minus 6-mesh concentrate contained approximately 90% of the gold. This was amalgamated for four hours in an Abbe pebble-mill, 1½ lb. of caustic soda was used per ton of sand, and the pulp contained 50% water. The plus 30-mesh tailing was permitted to go to waste.

The canvas-concentrate was amalgamated for four hours in a pebble-mill, using 1½ lb. of caustic soda per ton of sand and equal portions of water and sand.

The canvas-tailing was permitted to go to waste.

The results obtained were as follows:

	Weight Lb.	Assay Oz. per ton	Contents Oz. gold	Contents %
Bullion	0.5	...	3121.2	81.10
Concentrate, plus 6 mesh.....	66.0	3.94	0.1300	3.38
Concentrate, minus 6 mesh.....	114.8	5.37	0.3086	8.02
Tailing, plus 30-mesh.....	329.3	0.41	0.0675	1.75
Canvas-concentrate	8.4	0.73	0.0031	0.08
Canvas-tailing	217.2	2.01	0.2183	5.67
	736.0	10.46	3.8487	100.00

CONCLUSIONS AND RECOMMENDATIONS. In the treatment, the 736 lb. of sand was concentrated to 132½ lb. for amalgamation, which is 16.8% of the original weight. A gold recovery of 81.1% was obtained with a loss of two cents per pound.

The gold in this black sand was extremely difficult to amalgamate, owing to its intimate mixture with quartz. Had the heavier portions of the plus 6-mesh concentrate been carefully amalgamated and had the minus 6-mesh concentrate been amalgamated for a period of eight hours instead of four, the recovery would probably have been increased to 90% with a loss of but one cent per pound. This treatment, however, would not pay on such a low-grade material.

For a sand of this character, the simplest method of treatment is to screen out all coarse material that is practically free from gold, a point easily determined by panning.

The finer material can then be concentrated in a single-spigot classifier, using an upward stream of 54-ft. velocity per minute. About one-eighth of the material would be a concentrate which would have to be amalgamated. The gold recovered from this amalgamation would amount to 80% of the original gold in the sand.

In the treatment of a sand where a 20% loss would be prohibitive, the classifier-tailing should be passed over a fine screen (30 or 40-mesh), passing the fine over a canvas table and amalgamating the concentrate therefrom.

REVIEW OF MINING

SHUT-DOWN OF THE COPPER MINES

Announcement has been made of the suspension of production to take effect before April 15 at the following copper mines: Anaconda Copper Co., at Butte; Inspiration Consolidated company at Miami, Arizona; Utah Copper Co., at Bingham, Utah; Ray Consolidated, at Ray, Arizona; Chino Copper Co., at Santa Rita, New Mexico; Nevada Consolidated at Ely, Nevada; the Phelps Dodge mines at Bisbee and Clifton, and the smelter at Douglas, Arizona; the Calumet & Hecla group at Calumet, Michigan, the United Verde and United Verde Extension at Jerome, Arizona; the Shattuck-Arizona Copper Co. at Bisbee; the Arizona Copper Co. at Clifton; the Old Dominion Co. at Globe; and the North Butte Mining Co. To date the decision to close down has not been made by the Miami Copper Co., which is one of the few large companies still producing.

The following statement by R. C. Gemmel, manager for the Utah Copper Co., explains the reasons for this drastic move, and reflects the attitude taken by all of the companies.

"Since the Armistice the copper industry has suffered more than almost any other kind of business, because steel, sugar, and lumber and other principal industries continued, for some time, to do a large business at high prices. During the War, copper was sold at a price of only 50 to 60 % above the average pre-war price, whereas steel sold at from 300 to 500 % higher, and many other materials sold at an increase of more than 100 %.

"At the time the Armistice was signed this company was carrying a surplus of many millions of pounds of copper, which had been produced under conditions that warranted a price of at least 25c. per pound. The governments of the Allies also had large amounts of copper on hand and, in addition to that, there were millions of pounds in Europe in the form of scrap copper. An attempt was made to dispose of this copper surplus without ruinous injury to the industry; but instead of improving, business became worse, with the result that the price of the metal fell to less than the cost of production.

"Under these very adverse conditions the Utah Copper Co. has, at all times, endeavored to do the best it could for its employees. It was necessary to reduce wages in February and March 1919. These reductions remained in effect until July of last year, when a large increase in wages was granted in order to assist the employees to meet the increased cost of living.

"During February and March 1920 there was a material increase in the sales of copper at prices which, while not high, still left a margin of profit. The company hoped that this indicated an improvement in the business, and another increase in wages was made on April 1, 1920, which re-established the maximum war-time scale. This scale was continued in effect until January 1, 1921.

"Since the Armistice and to the first of this year the company has been operating on practically a 50 % basis. By the middle of the year 1920 the conditions of the industry were such that the scale of wages should have been reduced. However, the company continued to operate at a loss during the latter part of the year, without asking its employees to bear any of the loss.

"During the year 1920 our surplus of unsold copper increased by some millions of pounds. About the first of this year we made another curtailment, but even with this curtailment we have not been able to dispose of more than a limited portion of the output and then only at prices several cents below the actual cost of production.

"Under the conditions above outlined drastic action became imperative. I very much regret to announce that I have received instructions to the effect that complete cessation of production is absolutely necessary and that same will be made effective as soon as the mines and plants can be cleaned up and put in condition for an indefinite period of suspension, or until such time as the copper metal market warrants resumption of operations. During this period of suspension we will employ as many of our working force as we can, and will endeavor to co-operate with the men to ameliorate the conditions among the families of those who cannot be so employed and who cannot find work elsewhere."

INTERNATIONAL MINING CONVENTION AT PORTLAND

The third annual convention of the International Mining Congress was held at Portland, Oregon, during the week of April 5 to 9. The convention was opened by Harry M. Parks, chairman of the executive committee, and addresses of welcome were given by Governor Roy W. Olcott and Mayor George L. Baker. Among the speakers at the various sessions were Edwin Ludlow, newly elected president of the A. I. M. & M. E., Bradley Stoughton, secretary of the Institute, William Sloan, Minister of Mines for British Columbia, who talked on the mining industry of that Province, Sidney Norman, editor of the 'Northwest Mining Truth' of Spokane, Emmet D. Boyle, Governor of Nevada, Robert N. Bell, of Boise, Idaho, who talked on the phosphate-rock industry, and T. A. Rickard, editor of the 'Mining and Scientific Press', who gave an address on 'Prospecting, Past and Future'. The tariff on minerals and metals was discussed by Stanley A. Easton, manager for the Bunker Hill company, and Frank M. Smith of the same company. On the program were also the following papers regarding the mining industry of Alaska: 'Alaska's Legislative Requirements', by M. D. Leehy, 'Past and Future of Alaska', by Falcon Joselyn, 'Alaska from the Prospector's Standpoint', by George Hazlet.

W. H. TAFT TO UNDERTAKE INVESTIGATION OF A. S. & R. AFFAIRS

The American Smelting & Refining Co. has received from William H. Taft a letter in which Mr. Taft agrees to undertake the investigation of the affairs of the company as suggested to the Board of Directors by Messrs. Guggenheim. Mr. Taft's letter says:

"I have yours of March 25th, in which you enclose a draft of a circular which has been printed announcing that you have invited me to make the investigation requested in the letter of the Guggenheim brothers. If I understand the proposal, it is that the Board of Directors, elected at the next election, shall invite me to act in the capacity of an impartial investigator or arbitrator, to consider all the charges made by Mr. Eilers as former Vice-President of the company, as

to the transactions of the company. I assume you intend that Mr. Eilers shall be given full opportunity to present such evidence of the transactions as he may choose, and that those whom you represent will have equal opportunity, and that my conclusion shall be a judicial one. With that understanding and with the further understanding that I may have sufficient time, after my present engagements, to do this work, I shall be willing to accept the task and render a decision upon the issues thus made, as a judge. (Signed) William H. Taft."

In response to the foregoing, Edgar L. Newhouse, chairman of the board of the A. S. & R., has advised Mr. Taft that all of his conditions are agreeable to the company, and that Mr. Taft should understand that the invitation to him is extended by formal act of the present Board of Directors, which, in addition, pledges the co-operation of the Incoming Board.

A committee of five has already been organized to investigate the affairs of the American Smelting & Refining Co. It will at once seek to determine the validity of charges of mismanagement made by former vice-president and director Karl Eilers. The committee is said to be entirely impartial and is in no way affiliated either with the management of the company or those who are attacking the management. The committee is composed as follows: Henry Evans, chairman of the board of the Continental Insurance Co.; Clarence H. Kelsey, president Title Guarantee & Trust Co.; Henry K. Pomroy, Denny Pomroy & Co.; Willis D. Wood, of Ladd & Wood; Henry Whitton, president of the Union Sulphur Co.

The Title Guarantee & Trust Co. is the depository, and Rumsey & Morgan, of New York, are the committee's counsel. It is proposed to take immediate and aggressive action. Some large stockholders desire to know whether the Messrs. Guggenheim, with their private interests centred in the firm of Guggenheim Bros., and as dominating the management and board of directors—to the exclusion of customary stockholding representation—of the American Smelting & Refining Co., are able to fulfill their obligations to the stockholders.

NEW CORNELIA COMPANY'S EARNINGS EXCEEDED DIVIDENDS IN 1920

The annual report of the New Cornelia Copper Co. for 1920 shows net earnings of \$991,136, equal to 55c. per share, compared with \$17,246 earned in 1919, and \$2,527,806, or \$1.40 per share in 1918. Two dividends of 25c. each were paid in 1920. Copper on hand at the close of the year was estimated at 12½c. per pound. The company produced 40,104,493 lb. of copper last year, while deliveries amounted to 34,146,769 lb., for which an average price of 18.56c. was received. The income account compares:

	1920	1919
Metal sales	\$7,089,512	\$6,670,682
Other income	65,824	79,728
Total income	7,155,337	6,750,421
Operating expense	*4,530,670	5,149,222
Net income	2,624,666	1,601,198
Interest, depreciation, and depletion	1,633,530	1,593,952
Net profit	991,136	17,246

*Includes State and Federal taxes, which amounted to \$594,939 last year.

U. S. SMELTING CO. PASSES DIVIDEND

The Directors of the United States Smelting, Refining & Mining Co. voted to pass the dividend on the common stock. Three months ago the common dividend was cut from \$1.50 to 50c. The regular quarterly dividend on the preferred stock of 87½c. has been declared payable April 15 to holders of record April 6. The annual report for 1920 shows

consolidated profits for the year of \$6,777,000 and after providing reserves of \$1,865,223 for depreciation and depletion and \$2,002,502 for the reduction to market prices of metal inventories, the net profits, with taxes taken care of, show \$2,909,275.

These profits are equal to \$3.50 per share (7%) on the preferred stock and \$2.44 per share (6.88%) on the common stock. As dividends of \$5 per share were declared on the common stock during the year, the surplus of profit and loss was reduced by \$648,525 to \$16,781,591. The net current assets show a decrease of \$3,315,412 to \$11,355,315, there having been expended for new properties, improvements, and other capital additions \$4,343,621; this amount includes the purchase of the Arevale and Cardonal properties in Mexico.

The consolidated earnings for the first two months of this year are estimated at \$319,000, after providing reserves for depreciation and depletion and reserves for further exploration work in Mexico, aggregating in all \$251,000, the net earnings for the two months will show about \$68,000. The preferred dividend for the first quarter now declared amounts to \$426,556. Prices of metals are abnormally low and production is being reduced still further. Operating costs are gradually being lowered with the probability of still further reduction.

ARIZONA

Bisbee.—Although the Copper Queen branch of the Phelps Dodge Corporation will discontinue the production of copper on April 15, the company will retain in its employ about 1000 men to carry on development work. The average payroll in normal times is 3500, but on account of gradual reductions in operations not more than 500 men will be laid off. Married men and men who have purchased homes will be given preference.

Jerome.—Work on the new hoist-room on the 500-ft. level of the United Verde Copper mine has been going on for two years, but is not completed. The hoist-room is remarkable in many respects. It is reached through a tunnel a quarter of a mile long, hewn out of solid rock. When completed the hoist-station will resemble a railroad terminal. It is constructed entirely of cement, brightly lighted, and furnished like an office building. The room containing the electrical machinery is 40 by 45 ft., and the ceilings are 44 ft. high. There is an adjoining room 20 by 30 ft. The loading platforms are in another room. As the cage is double-decked, having a capacity of 50 men to each cage, the loading platform is also double-decked, having a subway to the lower cage so that both decks may be loaded at the same time. When the doors of the cage are fastened securely and safely an electric connection is made that conveys the signal to the engineer. The cages themselves have a net weight of 10½ tons. Loading stations and elevator shafts are of concrete construction down to the 1900-ft. level.

Bert Campbell, superintendent, has recently announced that preparations are being made to resume development work at the Jerome Superior about April 15. Mr. Campbell represents the anti-Mitchell faction which is now in control of the affairs of the Jerome Superior company and expects the temporary injunction in their favor will be made permanent when the case is again taken up. A few men are now unwatering the 1000-ft. shaft.—The Howard Copper Co., the mines of which are situated in Black Canyon, is sinking a two-compartment shaft, installing a 40-hp. hoist, and an Ingersoll-Rand compressor. The new equipment with that already installed is large enough to carry development to the 1000-ft. level.—William F. Burns, president of the Verde Mines & Milling Co., has announced that 10 additional stamps are to be installed in the mill immediately. The mines of the company are situated south of the Shea and

Copper Chief mines. The company also owns the Monarch mine near Jerome.

Kingman.—E. J. Carter reports that financing of the Tuckahoe mine at Chlerville has been completed and that the work of sinking the shaft 300 ft. deeper will be commenced immediately. The mine has been developed extensively on the upper levels and some ore is blocked out.—The cross-cut being run on the 400-ft. level of the Diamond Joe mine has opened a new shoot carrying exceptionally rich silver-lead ore in a four-foot vein. Ore is being sorted for shipment.

The shaft of the Gold Ore mine at Gold Road has reached the 700-ft. level and a station is being cut preparatory to cross-cutting to the vein 20 ft. from the shaft. The man-

Ray.—The property of the Silver King of Arizona Mining Co. will be sold to satisfy judgments entered against the company in the Superior Court of Pinal county. The judgments total \$361,854. Of this amount the Empire Trust Co. of New York represents \$327,370.

Tombstone.—The re-built mill of the National Metals Recovery Co. is now treating ore from the old dumps. According to J. W. Stockham, mill superintendent, 75 to 100 tons of ore per day will be concentrated.

Tucson.—The mine of the Mineral Hill Consolidated Copper Co. situated in the Mineral Hill district south of Tucson has been shut-down. The pumps have been removed from the mine as well as rails, pipes, electric wiring, and other perishable equipment. This company was one of the largest



The Miami Concentrator at Miami, Arizona

agement expects to commence shipments the latter part of April.

Prescott.—Suit to quiet title in a lode-mining claim has been filed against the United Verde Copper Co. by the Arkansas & Arizona Copper Co. The complaint alleges that the United Verde is filing notice of patent on part of a claim to which the Arkansas & Arizona has title. The constitutionality of the mining-claims assessment exemption act will be brought into this suit, as proof of the title of the Arkansas & Arizona to the claim can be determined from the county records except with regard to the years 1917, 1918, and 1919, when no assessment work was done, although notice of intention to hold the claim was filed, and exemption asked under the act of Congress.—A strike of rich silver ore is reported from the Turkey creek district, on a prospect owned by Clark Elmer. The vein has been explored from the surface to a depth of 30 ft., and assays run from \$1000 to \$2000 per ton.—The Valley Oil & Refining Co. has been incorporated for the exploration and development of property at Del Rio. Application has been made to the State for authority to prospect over land amounting to about four sections.

independent shippers of copper to the Phelps Dodge smelter in 1917.

CALIFORNIA

Angels Camp.—A class of 48 men, majoring in geology and mining at the University of California, arrived here on March 2 for a week's stay. Half of their time will be devoted to a study of the general structure of the district, and the remainder will be taken up with a more detailed study of the Mother Lode.—The Triple Lode Mining Co. is continuing development on the westerly or third lode, on the old Blair Consolidated property. The continuance of the wide shoot of ore is reported. The old Hardenburg mill, now at the property, is to be erected during the summer.—The Angels Camp Deep company started its 20-stamp mill on March 3. The company is employing about 25 men. Alfred Hunt is superintendent.

The Toll Gate Mining Co., in the district west of Altaville intends to install more and heavier machinery; it will also straighten and widen its shaft, and sink another 100 ft. immediately. This is the old Port Arthur ground.—The Victor Mining Co. has pumped out the shaft, put down by the Rainier company, and is running an inclined winze to

a vertical depth of 50 ft. below the sump, with the intention of raising to the sump, and by this method deepening the shaft. This will put the shaft on bedrock level and will obviate the necessity of working in the very wet ground. South of the Victor on the same channel in the Hullerl ground the old shaft, put down during the early 'sixties, has been pumped out, after four months work, and the old workings bottomed.

The operators of the Waterman mine, on the West lode south of Angels Camp, are planning a development work for the summer. During the winter the sawmill has been running and a good supply of mining timber is in stock. — The raise in the Finnegan mine, on Carson hill, reached the surface from the 600-ft. level during the past week. The mill is in course of construction. The ore-shoot has been developed on the latter level for a distance on the strike of 232 ft. with a width of 18 ft. at the north end and 8 ft. on the south end.

The Carson Hill Gold Mining Co. has completed the installation of its additional 10-stamp unit and has now 30 stamps with Hardinge mills for re-grinders. Further development on the Melones shoot and on the Morgan shoot is favorable. About 300 to 360 tons of ore is being treated in the 20-stamp mill; 200 men are employed.

Downieville.—The five-stamp battery at the Bessler gold quartz mine has been installed. Work on the tramway is in hand and the plant should be ready for operation by May 1. — A 400-ft. adit will be run to the main channel at the Golden Oak gravel mine. The Golden Oak lies between the Extension and Mammoth Springs mines, both large producers in the early days of the camp.

Engels.—The Engels Copper Co. is operating steadily in spite of the present low price for copper.

Iron Mountain.—The store and hospital building at the Iron Mountain mine, recently shut-down by the Mountain Copper Co., will be moved to the Hornet mine.

Keddie.—The Mitchell Mining Co. has acquired and will operate the Smith mine near here.

Plymouth.—At the Plymouth Consolidated mine a 15-ft. vein has been opened on the 3235-ft. level. The ore is said to be richer than any found for some time.

Redding.—Federal Judge Rudkin, of the U. S. District Court, has decided against Shasta county in suits brought by the Mountain Copper Co. and the Balaklala Copper Co. to recover taxes paid in 1919 under protest, on the ground that assessments were made arbitrarily. As a result of the decision the county government will return approximately \$15,000 to the Mountain Copper Co. and \$5000 to the Balaklala company. The same erroneous assessments were made in 1920.

Rich silver ore has been found in the old Chicago mine near Igo. A 14-in. vein is said to have been exposed for 170 ft. The ore is being tested by flotation with excellent results indicated to date. The mine was located in 1866 and rich ore was shipped to Swansea, Wales, for reduction.

San Francisco.—A Gold Producers Executive Committee has been organized to take charge of the campaign in behalf of the McFadden gold excise-tax bill now before Congress. Fletcher Hamilton, State Mineralogist, has been made chairman of this committee, and headquarters have been opened at 57 Post street. The membership includes the following well-known mining men: W. J. Loring, Bulkeley Wells, W. P. Hammon, George W. Starr, W. P. Henry, E. C. Voorbeis, B. L. Thane, Roy H. Elliott, H. R. Plate, William Devoreux.

COLORADO

Cripple Creek.—Recent development in the 2350-ft. level in the Portland company's No. 2 shaft, is proving up the deepest and richest gold vein in the State. Mining men declare it is the richest deep gold shoot on record. Mine

samples of better than 25 oz. are common, while a rich seam has assayed 60 to 100 oz. gold per ton. Ore as broken is milling close to \$40 gold and it is broken more than eight feet wide in the stopes, according to the statement of miners employed. The management is reticent, although admitting the mining of high-grade ore.

DeBeque.—The Index Shale-Oil plant here is nearing completion. The building is completed and machinery is now being installed. The 75-ft. retort is in place but it will be some time before a trial run is started.

Dillon.—The Mineral Point Tunnel & Mining Co. is completing the long adit which will drain its property in the Heaver Dam district and also provide haulageway for the ore developed in its property. It is said that a zinc-oxide furnace is to be constructed at the entrance to the adit.

Montrose.—The Standard Chemical Co. has resumed operations; 150 men are employed in the carnotite mines and reduction works. John I. Mullen, manager, declares that the market for radium is good and that the scale of operations will be increased.

Ouray.—Since cutting the Blanchard vein on the Des-Ouray level, the Deurades Mining Co. has drifted for 75 ft. When first cut the vein was five feet wide, the principal value of the ore being its lead content. Now, copper predominates, the average value in an eight-foot vein being \$60 per ton.

Telluride.—The steel structure for the flotation plant at the Smuggler Union property is complete, and machinery is being installed. It is hoped to have everything ready for operation by June 1. The company needs from 30 to 35 miners.

The Independence group at Placerville, 18 miles west of Telluride, has been taken over under bond and lease by the Big Four Mining Co., organized at Denver. Six men are already employed and the force will shortly be increased. The property produces a silver ore with low gold content. — Silver-copper ore has been opened up on Leopard creek, one mile north of Placerville, samples assaying as high as \$100 per ton. The property is owned by S. J. Adams of the Placerville hotel.

IDAHO

Bay Horse.—The mill of the Ramshorn Mines Co. has been closed since early in December due to shortage of water for power purposes. Meantime development of the mine has been carried on with a full crew. There is expected to be sufficient water for full operations in April, according to G. A. Joslin, managing engineer.

Coeur d'Alene.—Mining costs at properties operated by the Coeur d'Alene syndicate have decreased 40% during the last year, according to Rush J. White, engineer and manager for the syndicate. He says: "Conditions in every way are much more satisfactory than during the summer. Costs, particularly labor, are less and we are spending about what we figured in advance, instead of a large percentage above it, as we spent all summer. The total decrease in our labor costs now amounts to about \$7 per foot, of which \$2 represents decreased wages and the rest a greater interest on the part of the men. Our supplies have not decreased proportionately. With our present crew we are averaging about eight feet per day, running an 8 by 8-ft. adit." The syndicate recently took over the Black Bear and Senator groups; it has done 2678 ft. of development work of which 330 was cross-cutting and there is 7000 ft. still to be done before the ground will have been satisfactorily prospected. Eighteen men are at work. Two veins have been cut in addition to the Black Bear vein.

The Rice Mining & Milling Co., working on the Mother Lode claim on Big Creek, has received machinery, including mine-cars, electric plant, air-compressor, and machine-drills. The ore is free-milling and can be satisfactorily treated at

the mine. A small mill and hydro-electric power-plant with capacity for a 500-ton mill will be installed later.

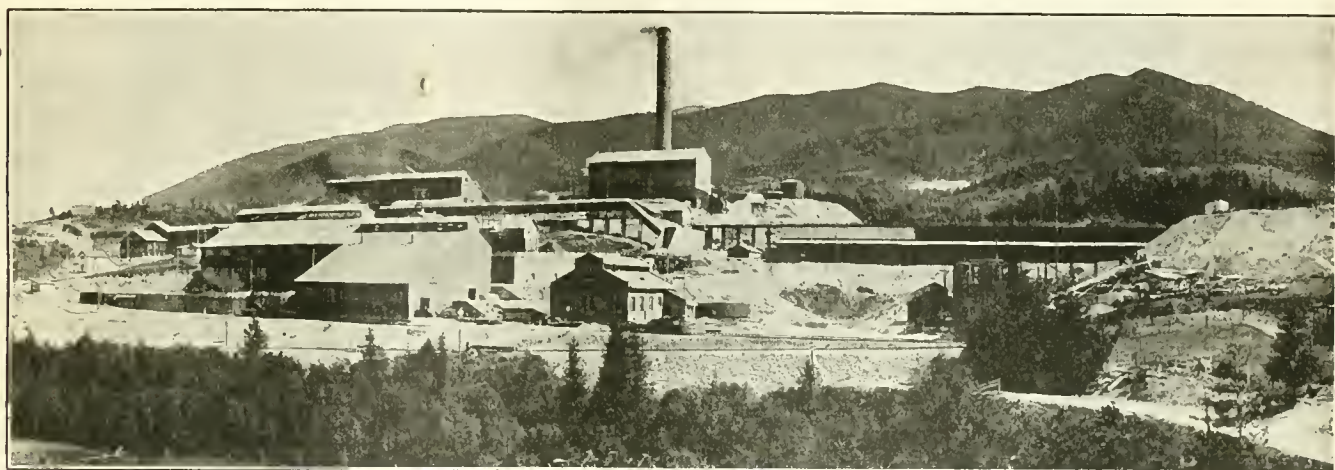
About 225 tons of concentrate is being shipped monthly by the Mullan Milling Co., working a lease on Government gulch, west of Kellogg. The ore is said to carry 75 oz. of silver per ton and to average 25% lead. The company has been operating the dumps of the Ontario, Silver King, and other big mines and it is said the company still has enough ore to run three or four years. Last year over 3000 tons of concentrate was shipped.—The owners of the Slavonian group on Milo creek, opposite the Last Chance compressor, are making preparations to start development work. It is the intention to continue the lower tunnel, which is now in 850 ft., to cut the vein showing in the outcrop. A good showing of silver-lead ore is reported.

Charles R. Mowery, president of the Highland-Surprise Consolidated Mining Co., in the Pine Creek district, says: "We are able to make the announcement that there will be a home market for the ores of the Highland-Surprise in the near future. The Bunker Hill company has stated its in-

lb. of 1920 copper remains unsold and to this must be added 3,682,200 lb. produced in January and February of this year, little of which has been marketed. In the case of Isle Royale a similar situation holds true.

An important reduction in freight charges on copper shipped by water to Buffalo or by water and rail to points east has just been announced. This probably will result in the withholding of some copper deliveries until the opening of navigation inasmuch as the rail-rate on the metal is high. The Buffalo water-rate from Houghton, Hancock, Dollar Bay, or Hubbell will hereafter be 29c. per 100 lb. instead of 35 as last year, while the lake-rail rate to New York, which will apply to export shipments, will be 49c. this year instead of 59c. as last year. The lake-rail rate to Boston will be 51c. instead of 61.

The Mayflower east cross-cut is now entirely in vein matter. The lode, which is believed to be the Mayflower, has been showing in the roof of the cross-cut until recently. The copper showing is of a nature to lend much encouragement to present operations. The cross-cut will continue to



The Bunker Hill Smelter

tention of building a zinc smelter and this plant will be equipped for the treatment of such ores as are produced in the Pine Creek district. This will do away with the high freight-rates that have prevailed in the past and should also ensure the early completion of the railroad into the Pine Creek district. Ore opened on the Surprise level is of good milling grade, containing lead, silver, and zinc."

MICHIGAN

Calumet.—Calumet & Hecla has filled a few small orders for copper for domestic consumption, aggregating 100,000 lb. Demand for metal continues at low ebb and Calumet & Hecla has few large orders in sight. Surplus stocks are steadily increasing and Calumet & Hecla and its working subsidiaries now have fully a year's supply of metal on hand.

In 1920, C. & H. sold 43,019,141 lb. It started 1920 with 32,449,559 lb. on hand, leaving only 10,569,582 lb. of 1920 copper actually sold. A total of 57,627,883 lb. was produced during the year and, striking a monthly average, the only metal produced in 1920 that was sold was that turned out in January and February and the first week of March. The copper refined throughout the remainder of the year, amounting to 47,058,301 lb. is part of the Calumet & Hecla surplus. To this must be added the 9,343,184 lb. produced in January and February this year, of which comparatively little has been sold.

Ahmeek sold 12,856,595 lb. of copper in 1920. At the beginning of 1920 it had 9,929,782 lb. on hand, leaving only 2,926,713 lb. of 1920 copper actually sold. It produced during 1920 a total of 20,489,438 lb. A total of 17,562,725

open the vein. The west cross-cut is again in copper-bearing amygdaloid after being in trap for a considerable distance. It is planned to go back in the cross-cut later and drift on a vein entered several weeks ago.

At New Arcadian the south drift from the New Baltic shaft has been extended toward the New Arcadian shaft for 75 ft. The north drift has been pushed 50 ft. Both drifts are in good looking ground.

MONTANA

Butte.—The recent report of Paul A. Gow, general manager for the Tuolumne Mining Co., states that the new boiler-plant has effected a large saving in fuel. A new centrifugal pump on the 1200-ft. level, consisting of two units of five stages each, is pumping 500 gal. per minute to the surface, a lift of 1200 feet.

Cooke City.—The Mohawk Mining Co., according to Frank Wells, has discovered a vein of rich silver ore.—F. A. Hancock, reporting on the property at the Glengarry Mining Co., says: "The first real systematic work of a permanent nature consists of driving a main working-tunnel, 5 by 8 ft., from the Jane claim where the main camp is situated. The tunnel will cross-cut the first known body of ore at a vertical depth of 360 ft. and the Spaulding orebody at a vertical depth of over 1000 ft. The tunnel is now in about 900 ft. and will be driven 450 ft. farther to reach the Maggie orebody and an additional 800 ft. to reach the Spaulding orebody."

Deer Lodge.—The 800-ft. shaft of the Champion mine has been unwatered to the 600-ft. point. The shaft is being

drained through a diamond-drill hole connecting with the main workings below.

Missoula.—A vein of gold-bearing quartz, said to be two feet thick and assaying \$500 per ton, is reported to have been opened by Joseph and Abe Mayo, at the old mining property south of St. Regis.

NEVADA

Elko.—The process used by the Catlin company for the extraction of oil from shale, with which the company has been experimenting on a large scale, has been pronounced a success by the superintendent of the plant here, who would not give details of the process.

Ely.—It is reported that 8% copper ore is being mined by the Boston & Ely Consolidated Co. The company is a consolidation of the Smoky Development, the Boston Ely, and the Ely Northern companies. The shoot thus far opened is 15 ft. wide and extends along the tunnel-level for a distance of 35 feet.

Eureka.—An experimental run of the Eureka Holly mill, where volatilization furnaces recently have been installed, is reported to have demonstrated the amenability of the ore. However, the mill has been shut-down because of shortage of motive-power.

Goldfield.—Shipping-ore has been discovered in the mine of the Goldfield Great Bend Co. in the Diamondfield section. Samples from mine-cars of the ore stoped average more than \$35 per ton, although much extremely high-grade material is being mined.

The Grandma is sinking for a sump below the 1000-ft. level, following which a cross-cut will be driven 75 ft. east to a point under the winze in which ore was found on the \$15-ft. level.

Gold Park.—The 50-ton mill of the Star of the West has been started, treating gold-silver-lead ore. Amalgamation, concentration, and flotation are used. There is said to be enough ore in the mine to keep the mill operating for four years.

Hamilton.—Thomas Lynch and Julius Goldsmith, of Tonopah, have organized the Eureka Hamilton Mining Co. with the intention of developing a group of claims on Treasure hill. The claims are in the district that produced \$40,000.-000 at the time of the great White Pine rush.

Klondike.—The Ben Hur has started shipping \$50 ore to Millers from the 50-ft. level of a shaft being sunk on the part of the claim that was bought from the Original Klondike. This shaft is being sunk and has now reached a depth of 75 ft. The ore contains silver glance.

Lone Mountain.—The Electric Gold Mines Co. is moving machinery to the old Weepah mine from Tonopah and buildings are being hauled 40 miles from Goldfield. Frank Ish, who is interested in the Electric, came from San Francisco recently and made plans to start work on adjoining claims owned by him. The Electric is well financed and not less than 10 men will be employed when mining is started after the machinery, which includes a 15-hp. hoist, has been erected. The dump at an 80-ft. shaft assays \$6.60 in gold and the bottom of the shaft assays \$7.40, with a 12-in. seam of \$15 to \$20 material. The main, or Electric, vein strikes north-east for 3000 ft. through the claims. At a point 100 ft. east of where a 55-ft. width of \$5.20 ore is exposed in a tunnel, there has been found in recent work on the surface a 3-ft. width of \$25 ore, which is well over shipping grade because the distance to the railroad is only 10 miles and the distance to Millers is about 15 miles. Frank Horton, promoter of the company, says his object is to build a mill on the claims. The present plan for mining is to sink to 300 ft. and prospect at that depth.

Mina.—The commissioners of Mineral county are preparing to issue bonds for the construction of a power line from

Hawthorne to Candelaria by way of the Simon district. The county also will buy the power line from Lundy, California, to Hawthorne.

Pioche.—The Prince Consolidated Mining Co. has resumed sinking the main shaft, the purpose being to explore the territory prospected by diamond-drills. Now that the water-level has been lowered it is expected that 175 to 200 gal. per minute will be made. — E. R. Richards and Maurice Peterson have completed the overhauling of the old Hull-Honville mill and power plant and are ready to commence treatment of tailing.

Pioneer.—The 15-stamp Mayflower mill is making a recovery of 85%, according to W. J. Tobin, the manager, who says 60% of the metallic content of the ore recovered by amalgamation and 25% by concentration. Ten tons of \$15 ore is being treated daily.

Tule Canyon.—C. D. Wilkinson, engineer for W. J. Loring, who a few days ago took charge of the Ingalls, being operated by the Silver Hills, is to remain here indefinitely as general superintendent. The mill is again being remodeled under direction of Wilkinson and when completed it is expected to treat 30 tons daily at a much smaller cost than formerly. A heavy item of expense at present is the large quantity of gasoline being used. Mr. Wilkinson says that ore is being found on the 200-ft. level, but that the drift had not been advanced far into the ore-shoot. He said the geological conditions were as puzzling now as they always had been and that the ore on the 200-ft. level was being found on the wall opposite to that on which he had thought it would be found.

Virginia City.—The Consolidated Virginia produced last week 784 tons of \$9.51 ore from the 1650-, 2150-, and 2250-ft. levels. Ore three feet wide and assaying \$300 has been opened above the 1650-ft. level at a point west of the shaft, it is reported.

Winemucca.—The Black Rock company, drilling for oil at Sulphur, will, about May 1, start sinking a two-compartment shaft to prospect a deposit of sulphur found while drilling.

UTAH

Eureka.—Shipments from the Tintic district for the week ending March 26 totaled 174 cars, as compared with 155 for the previous week. The Tintic Standard shipped 68; Chief Consolidated, 35; Dragon, 18; Iron King, 17; Iron Blossom, 11; Victoria, 5; Eagle & Blue Bell, 4; Swansea, 3; Grand Central, 3; Mammoth, 2; Colorado, 2; Bullion-Beck, 2; Eureka Hill, 1; Centennial-Eureka, 1; Gemini, 1; Alaska, 1.

Drifting operations have been resumed at the Eureka Bullion mine, according to John M. Bestlemeyer, manager. This work is on the 925 and 1150-ft. levels. The company has recently completed the re-timbering of the shaft to the 200-ft. level. On the 925-ft. level, an excellent showing of ore has been opened up by drifting to the north-east upon the fault-fissure. The ore averages three feet in thickness and assays from 45 to 114 oz. silver and from 8 to 38% lead. While no ore has been found on the 1150-ft. level, conditions are encouraging.

Park City.—Shipments from this district for the week ending March 26 totalled 1639 tons, a decrease of 225 tons from the previous week. The Judge Allied companies shipped 597 tons; Ontario, 550; and the Silver King Coalition, 492.

A. L. Thomas, manager for the New Quincy Mining Co., announces that a promising discovery of silver-lead ore has been made recently. So far 18 in. of ore has been opened, average assays of which give returns of 77 oz. silver, 40.9% lead, and 60c. in gold. The strike was made in a winze from a drift on the 700-ft. level of the Little Bell shaft. It is believed that the fissure is the same as the one from which production was taken on the 1200-ft. level some years ago.

Salt Lake City.—Immediate action on the part of Congress is necessary to save the domestic silver-lead mining industry from total suspension of operations, according to A. G. Mackenzie, secretary of the Utah Chapter of the American Mining Congress. Realizing the seriousness of the situation, Utah mine operators are planning to send a delegation to Washington when Congress convenes on April 11 to urge the passage of an anti-dumping law which will protect the lead industry in this country from foreign competition. Local silver-lead mining men are gloomy since lead declined to 4c. per pound, with a slow demand, even at that price. With silver at \$1 per ounce, the largest of the silver-lead producers in this State are just about breaking even. Operators therefore feel that an emergency exists that must be met immediately; by the time the regular tariff bill is enacted, lead producers may have been dealt such a blow that the majority of the mines will be inactive and their forces disorganized.

Charles R. Mabey, Governor of Utah, has appointed a com-

and an office. We have completed between 500 and 600 ft. of tunnel work in the east tunnel besides doing the assessment work on all claims not patented."

BRITISH COLUMBIA

Alice Arm.—L. J. Hughes, manager of the Bellevue mine, Illiance river, reports the cutting of a rich ore-shoot, carrying gray copper and galena, at a depth of 186 ft. The vein on which this shoot occurs is traceable on the surface for more than 3500 feet.

Princeton.—The Princeton Mining & Development Co. will re-commence immediately operations on its property, five miles south of Princeton. Excellent copper ore has been opened in three tunnels.—Work at the Gold King mine, on the Similkameen river, north of Oroville, has been re-started, according to recent advice.

Stewart.—Dale L. Pitt, superintendent of the Premier mine, has announced that the company has let a contract for an aerial tramway, between the mine and Stewart, to the



A Typical Street Scene in Mexico

mittee of mining men to consider the question of having an exhibit of the mineral resources of Utah at the National Exposition of Mines and Mining Equipment to be held in connection with the 24th annual convention of the American Mining Congress at Chicago, October 17 to 22. Among the mining men on the committee are: C. E. Allen, Ernest Bamberger, J. M. Bidwell, L. S. Cates, Fred Cowans, W. H. Child, Walter Fitch, O. J. Grimes, H. S. Joseph, Thomas Kearns, J. Will Knight, G. W. Lambourne, A. G. Mackenzie, Duncan MacVichie, Dr. Jos. F. Merrill, Imer Pett, E. J. Raddatz, F. W. Reynolds, V. S. Rood, J. R. Walker, and J. B. Whitehill.

WASHINGTON

Newport.—Construction work on the new mill of the Bead Lake Gold-Copper Mining Co. is progressing. George C. Geisler, president, says: "We have 70,000 ft. of logs on the rollway at the sawmill to be sawed for re-timbering the shaft on the Conquest and for building the aerial tramway, ore-bins, etc. During the last year we have built, in addition to the concentrator, a residence for the superintendent

Ribley Tramway Co., of Spokane. The tramway will be between 11 and 12 miles long and will have a fall of 1400 ft. Cold weather has put the road into good condition for sledging again, and transportation of ore has been resumed. It is hoped that the heavy gear for the new tramway will be delivered while the present crust of ice lasts, as this would considerably hasten the erection of the tramway. The cost of the equipment and erection will be about \$250,000. The 'Prince Albert', which left here on March 20, took nearly 700 tons of ore, running about \$400 per ton, to Tacoma.

Trail.—The Consolidated Mining & Smelting Co. has under consideration plans for the erection of a battery of by-product coke-ovens. In the past the company has used coke made in beehive ovens, at Fernie. The company could utilize the surplus gas from the ovens for the roasting of zinc concentrate, while flotation oils could be obtained from the tar. Ore receipts at the smelter for the week ended March 21 totalled 7746 tons, which, with the exception of 48 tons from the Horn Silver mine, all came from the company's own mines.

MEXICO

Agua Prieta.—Edward Butler, connected with the Rio Plata Mining Co., states that the mines of the company at Chinapas have been temporarily shut-down owing to the low price of silver. The Batopilas mine has also suspended operation.

ONTARIO

Beaverhouse Lake.—Sinking operations will be resumed at the Argonaut. The shaft now down 380 ft. will be sunk to the 500-ft. level. A station has been cut at 350 ft. at which level it is proposed to cross-cut the veins which are known to occur. A considerable tonnage of ore has been opened up on the 200-ft. level.

Cobalt.—Though the silver mining industry continues quiet conditions are improving and an early revival of activity is anticipated. The shortage of power has been relieved by recent heavy rains and the cost of material much reduced. An early settlement of the wage question is expected, the miners fully realizing that the reduction of wages is necessary, the only question being as to the date from which the cut is to go into force. Several mines will probably re-open in the course of a few weeks. The Temiskaming has its oil-flotation plant ready for operation and much ore developed which can be profitably treated.

Bullion shipments from the Cobalt district during the fourth week of March amounted to 420,707 oz. The Nipissing shipped 220,643.30 oz. while the Mining Corporation sent out 200,063.98.

Kirkland Lake.—The Teck-Hughes plans to increase the grinding equipment of its mill so as to enable the tonnage treated to be increased from 25 to 50%. The mill was constructed with this addition in view, so that the change can be effected at a moderate expenditure.—At the annual meeting of the King-Kirkland, C. F. Jordan was elected president and E. L. Wettlaufer vice-president, and a policy of operation adopted. The shaft is down 80 ft. on a vein the full width of the shaft, assays showing an average gold content of \$11.60. When the 100-ft. level is reached cross-cutting will be undertaken to reach some parallel veins, and surface exploration work will be continued. The company has 1,150,000 shares in its treasury.

The Kirk Gold Mines has arranged to commence work on three claims situated immediately west of the King-Kirkland.—The Queen-Lebel, a new company, has taken over three claims situated south of the east end of Gull lake and about 1½ miles east of the Tough Oakes, on which a number of promising veins have been found.

Porcupine.—Work at the 1050-ft. level of the Dome Mines has opened two rich orebodies, which are reported to be each upward of 30 ft. wide with gold content ranging from \$7.50 to \$20 per ton. Mill-heads have already increased nearly 50% over pre-war grade and everything indicates an increase in production during the coming summer.—The Premier Paymaster is being re-opened. A diamond-drilling contract has been let and the work has been started. A large orebody has been opened up at the 200-ft. level, and the drilling has been undertaken to determine the extension of the deposit east of the shaft.

The Porcupine Keora proposes to sell two of its mining claims to a new company to be capitalized at \$3,000,000 in shares of the par value of \$1, of which 2,000,000 shares are to be retained by the Keora. The company will still own three claims comprising an area of 120 acres.

West Shining Tree.—George R. Rogers, president of the Wasapika Consolidated, announces that arrangements have been made for the erection of a mill, the first unit of which will be of 100 tons daily capacity. It will subsequently be enlarged to 200 tons. It is hoped to have the mill in operation by the end of the year.

PERSONAL

The Editor invites members of the profession to send particulars of their work and appointments. The information is interesting to our readers.

D. G. Hendley, of Saltillo, Mexico, is at Denver.

George O. Bradley has returned from New York.

Alvin B. Carpenter has moved his offices from the Citizens National Bank Bldg. to 701 Pacific Finance Bldg., Los Angeles.

Loren D. Stanton, of Ruth, Nevada, is at El Segundo, California.

A. N. Mackay, of Medellin, South America, is at Sussex, England.

Morton Webber has returned to San Francisco from Salt Lake City.

Marshall Bond, of Santa Barbara, California, is at Houston, Texas.

H. C. Gemmell, accompanied by J. E. Cawley, his secretary, is in New York.

Ichiro Omori, professor in the Kumamoto Technical College, at Tokyo, is here.

Barclay G. Anderson has moved from Tyrone, New Mexico, to Berkeley, California.

Stephen Birch, president of the Kennecott Copper Corporation, is in the West.

William D. Ebbert, president of the old Spanish Town Mines Co., is at Rocky Bar, Idaho.

R. M. Haskell, metallurgist for the Calumet & Hecla Mining Co., is visiting Western mining districts.

Stewart Campbell, State Mine Inspector of Idaho, was at Salt Lake City during the latter part of March.

August S. Freeburg, secretary to the Basin Gold & Silver Mining Co., at Basin, Montana, is at Minneapolis.

L. A. Walker, superintendent for the U. S. Smelting & Refining Co., at White Knob, Idaho, has moved to Bingham, Utah.

Arthur C. Terrill has reached Tientsin and has taken up his new duties as professor of mining at Pei-Yang University.

A. W. Newberry, mining engineer, has returned to New York, after an absence of four months on professional business in Nicaragua.

Frank E. Grant, superintendent of steam-shovel operations for the Nevada Consolidated Copper Co. at Ruth, was at Salt Lake City last week.

A. J. May, who has been engineer at the Gemini mine at Eureka, Utah, has been appointed superintendent of the Tintic Standard mine, to succeed John Westerdahl, who recently was shot and killed in a holdup at Dividend.

Obituary

George W. Crismon, age 40, mining engineer of Salt Lake City, died on March 25, following an illness of five weeks. He was born at Salt Lake City and lived in Utah the greater part of his life. He was a graduate of the Utah Agricultural College at Logan and of the State University. After leaving school, he became a member of the assaying firm of Crismon & Nicholls, one of the largest companies of its kind in the inter-mountain country. For a number of years he was connected, in various capacities, with the Utah mine at Fish Springs, and for the past four years, held the position of consulting engineer. He was also interested in a number of other mining companies in Utah. He is survived by his mother, a brother, and a sister.

THE METAL MARKET



METAL PRICES

San Francisco, April 5

Aluminum-dust, cents per pound.....	75
Antimony, cents per pound.....	7.50
Copper, electrolytic, cents per pound.....	13.00—13.50
Lead, pig, cents per pound.....	4.50—5.50
Platinum, pure, per ounce.....	\$75
Platinum, 10% iridium, per ounce.....	\$105
Quicksilver, per flask of 75 lb.....	\$45
Spelter, cents per pound.....	7.50
Zinc-dust, cents per pound.....	12.50—15.00

EASTERN METAL MARKET

(By wire from New York)

April 4.—Copper is more active and firm. Lead is quiet and higher. Zinc is lifeless and unchanged.

SILVER

Below are given official or ticker quotations for silver in the open market as distinguished from the fixed price obtainable for metal produced, smelted, and refined exclusively within the United States. Under the terms of the Pittman Act such silver will be purchased by the United States Mint at \$1 per ounce, subject to certain small charges which vary slightly but amount to approximately three-eighths of one cent. The equivalent of dollar silver (1000 fine) in British currency is 40.65 pence per ounce (925 fine), calculated at the normal rate of exchange.

Date	New York	London	cents	pence	Average week ending	Cents	Pence
Mch. 29.....	57.25	33.25			Feb. 21.....	58.81	34.04
" 30.....	57.50	33.37			" 28.....	55.67	32.22
" 31.....	57.25	33.12			Mch. 7.....	54.18	31.52
Apr. 1.....	56.12	32.50			" 14.....	55.12	32.04
" 2.....	56.37	32.50			" 21.....	56.69	33.00
" 3 Sunday.....					" 28.....	57.69	33.45
" 4.....	57.00	33.12			Apr. 4.....	56.92	32.98

Monthly averages

Date	1919	1920	1921	1919	1920	1921
Jan.	101.12	132.77	65.95	July	106.30	92.04
Feb.	101.12	131.27	59.55	Aug.	111.35	96.23
Mch.	101.12	125.70	56.08	Sept.	113.92	93.66
Apr.	101.12	119.56	...	Oct.	119.10	83.48
May	107.23	102.69	...	Nov.	127.57	77.73
June	110.50	90.84	...	Dec.	131.92	64.78

COPPER

Prices of electrolytic, in cents per pound.

Date	Average week ending	Date	Average week ending
Mch. 29.....	12.62	Feb. 21.....	12.83
" 30.....	12.62	" 28.....	12.67
" 31.....	12.62	Mch. 7.....	12.43
Apr. 1.....	12.75	" 14.....	12.16
" 2.....	12.75	" 21.....	11.87
" 3 Sunday.....		" 28.....	12.15
" 4.....	12.75	Apr. 4.....	12.68

Monthly averages

Date	1919	1920	1921	Date	1919	1920	1921
Jan.	20.43	19.25	12.94	July	20.82	19.00	...
Feb.	17.34	19.05	12.84	Aug.	22.51	18.00	...
Mch.	15.05	18.49	12.20	Sept.	22.10	18.75	...
Apr.	15.23	19.23	...	Oct.	21.66	16.53	...
May	15.91	19.05	...	Nov.	20.45	14.63	...
June	17.53	19.00	...	Dec.	18.55	13.18	...

LEAD

Lead is quoted in cents per pound, New York delivery.

Date	Average week ending	Date	Average week ending
Mch. 29.....	4.25	Feb. 21.....	4.52
" 30.....	4.35	" 28.....	4.12
" 31.....	4.40	Mch. 7.....	4.06
Apr. 1.....	4.45	" 14.....	4.04
" 2.....	4.45	" 21.....	4.00
" 3 Sunday.....		" 28.....	4.00
" 4.....	4.45	Apr. 4.....	4.39

Monthly averages

Date	1919	1920	1921	Date	1919	1920	1921
Jan.	5.60	8.05	4.96	July	5.53	8.63	...
Feb.	5.13	8.88	4.54	Aug.	5.78	9.03	...
Mch.	5.24	9.22	4.06	Sept.	6.02	8.08	...
Apr.	5.05	8.78	...	Oct.	6.40	7.28	...
May	5.04	8.55	...	Nov.	6.76	6.37	...
June	5.32	8.43	...	Dec.	7.12	4.76	...

TIN

Prices in New York, in cents per pound.

Date	1919	1920	1921	Date	1919	1920	1921
Jan.	71.50	62.74	35.94	July	70.11	49.29	...
Feb.	72.44	59.87	32.18	Aug.	62.20	47.60	...
Mch.	72.50	61.92	28.87	Sept.	55.79	44.43	...
Apr.	72.50	62.17	...	Oct.	54.82	40.47	...
May	72.50	54.99	...	Nov.	54.17	36.97	...
June	71.83	48.33	...	Dec.	54.94	34.12	...

ZINC

Zinc is quoted as spelter, standard Western brands, New York delivery, in cents per pound.

Date	Average week ending	Date	Average week ending
Mch. 29.....	5.15	Feb. 21.....	5.35
" 30.....	5.15	" 28.....	5.20
" 31.....	5.15	Mch. 7.....	5.10
Apr. 1.....	5.15	" 14.....	5.25
" 2.....	5.15	" 21.....	5.25
" 3 Sunday.....		" 28.....	5.20
" 4.....	5.15	Apr. 4.....	5.15

Monthly averages

Date	1919	1920	1921	Date	1919	1920	1921
Jan.	7.44	9.56	5.86	July	7.78	8.18	...
Feb.	6.71	9.15	5.34	Aug.	7.81	8.31	...
Mch.	6.53	8.93	5.19	Sept.	7.57	7.84	...
Apr.	6.49	8.76	...	Oct.	7.82	7.50	...
May	6.43	8.07	...	Nov.	8.12	6.78	...
June	6.91	7.92	...	Dec.	8.69	6.03	...

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, according to quantity. Prices, in dollars per flask of 75 pounds.

Date	1919	1920	1921	Date	1919	1920	1921
Mch. 8.....	47.50			Mch. 22.....	45.00		
" 15.....	45.00			" 29.....	46.00		
				Apr. 5.....	45.00		

Monthly averages

Date	1919	1920	1921	Date	1919	1920	1921
Jan.	103.75	89.00	50.00	July	100.00	88.00	...
Feb.	90.00	81.00	48.75	Aug.	103.00	85.00	...
Mch.	72.80	87.00	45.88	Sept.	102.00	75.00	...
Apr.	73.12	100.00	...	Oct.	86.00	71.00	...
May	84.80	87.00	...	Nov.	78.00	50.00	...
June	94.40	85.00	...	Dec.	95.00	52.50	...

OUR ECONOMIC OBLIGATIONS

In a recent address, Frank H. Sisson, vice-president of the Guaranty Trust Co. of New York, said in part as follows:

"We are too prone to think in terms of what the United States means to the remainder of the world. It is high time for us to realize fully what the rest of the world, and especially Europe, means to this country. We have lately put too much emphasis on our help to other nations; we need to understand that we require their assistance.

"Ever since the Pilgrim Fathers landed on these shores three hundred years ago we have looked to Europe for help in developing this great land. And we need Europe's aid today quite as much as, if not more than, in the past. It is a different kind of assistance, however, that we require now. Heretofore we have sought and obtained Europe's money and men. Today we do not need either of them, at least in the quantities that we received before the World War—in fact, it would be to our serious detriment to take them in such quantities. But we do need European markets to preserve our national prosperity, and that fact, clearly foreseen long ago by the keenly observant, is just beginning, apparently, to dawn upon popular consciousness.

"While it is true that the United States is more nearly economically independent than any other World Power and that the great market for our products is our own country, nevertheless, we are economically dependent upon other nations to a larger extent than has generally been understood. And not only has that extent not been appreciated by the mass of our people, but also its vital significance to our welfare. Were that fact properly understood, we would not be selfish in our point of view and international policies but far more selfish; and, paradoxical though it seem, through greater selfishness we would be less selfish. In other words, we would realize that by helping others more we would help ourselves most.

"The surplus copper, raw and refined, in this country is estimated at more than one billion pounds. Europe formerly took about half of our copper, and the world depends upon the mines, refineries, and smelters of the United States for its copper. Yet, despite our enormous surplus, the whole world has not been so badly in need of copper in years as it is today. Lack of credit alone has been responsible for the piling up of that surplus of the red metal. Five years of war have devastated hundreds of thousands of square miles of highly productive industrial areas.

"It is clear that what is chiefly needed in the situation is that form of action that would force into motion again the interchange of commodities between all the now stagnant markets of the world. The spot at which the channels of this movement are clogged is evident enough to all eyes. It is in Europe, with its idle workers, its under-fed peoples, and its struggling industries. The exchange difficulty now definitely blocks the normal method of free purchases by nations in which currencies are at such low levels, yet it is vital for the interest of all that these nations shall secure supplies, just as it is essential that in other countries idle and accumulating surplus stocks of food, raw materials, and manufactures shall be utilized for the support and stimulation of the world's activities."

MONEY AND EXCHANGE

Foreign quotations on April 5 are as follows:

Sterling, dollars:	Cable	3.92
	Demand	3.91
Francs, cents:	Cable	7.02
	Demand	7.00
Lire, cents:	Demand	4.18
Marks, cents:		1.66

Eastern Metal Market

New York, March 30

The only change in the general situation is an advance in copper prices, due largely to a sharp curtailment in production. Demand for all the metals continues light.

There is little domestic buying of copper, but prices have advanced as indicated above.

Buying of tin is light but values are nominally slightly higher.

Lead is relatively scarce but demand is of small proportions with prices firm.

The zinc market has not improved and prices are easier.

IRON AND STEEL

Increased operation of automobile plants is the main cause of betterment in the steel situation this week, says 'The Iron Age'. Apart from the Ford company, the motor industry is now running at about 25% of capacity, and releases of suspended steel orders have helped some mills.

As a whole the steel industry is somewhat under one-third operation. Some of the Steel Corporation's plants in the North, particularly in the Chicago district, are rolling less product, while its Alabama mills are doing better. Some independent companies are working more men, notably sheet mills at Youngstown; others, after a fortnight of fair operation, are easing off.

COPPER

A marked change has come over the market; it is an unusual one, due to unusual causes. It has resulted in a sharp marking up of prices which have been substantiated by some sales. There have been rumors for some weeks of further curtailment in production by various companies. The culmination came yesterday with the announcement of the closing down of all of the porphyry companies and the confirmed rumor of cessation at the Anaconda property. The reason in the case of the former is that cost of output is so high that there is no margin of profit, which with stocks ample leaves no alternative except to shut-down. As a result of these conditions prices have been advancing slowly the past week. Yesterday electrolytic copper was quoted and sold at 12.75 to 13c., delivered, for early delivery, which is 12.62½ to 12.87½c., New York, or refinery. While demand is small, it is claimed that not much metal is available at these prices. Lake copper sellers, some of whom have been out of the market for some weeks, are conservatively quoting the market at about 13 to 13.25c., delivered, for early delivery. Domestic demand is very light and there is no prospect of its growing. Foreign demand has been better and thus far this year exports have been as heavy or heavier than in the same time in 1919 or 1920. For February and January the total has been more than for the same two months in 1920 and in January, Germany was the largest purchaser, taking 8394 gross tons out of a total of 24,068 tons, or about one-third.

TIN

The four-day holiday in the London market, or from Thursday night to Tuesday, the Easter holidays, has had a pronounced effect on the American market. A notable feature of the market is that there are still few sellers, which renders the technical position favorable. Prices of Straits tin are largely nominal, with the quotation yesterday at 29.50c., New York, against 30.25c., on Monday, and 28.50c. a week ago. London opened yesterday low at £161 10s. for spot standard, £165 future standard, and £167 10s. for spot Straits. Ordinarily after a holiday such as the past few days, accumulated orders would cause a higher rather than a lower opening. As it is, quotations were £4 to £5

per ton above a week ago. Arrivals thus far this month have been 1583 tons with only 400 tons reported afloat, the smallest in many weeks. American pure tin is quoted at 29c. and 99% tin at 28c.

LEAD

The news feature is the announcement late Monday of an advance in the price of the leading producers from 4c. to 4 1/10c., New York and St. Louis. It appears that this maker had virtually ceased selling at 4c., its former price, and just what the new quotation means is not at the moment clear. Independent producers are quoting 4.25c., New York, and 4c., St. Louis, which is the market at present, as the little business being offered is believed to be going at the outside-market prices. Production has been decidedly curtailed generally and though demand is light, the metal is hard to obtain. Any spurt in orders would result in a decided advance in the present state of the market.

ZINC

There is no change in the fundamental conditions ruling this market. Demand continues hand-to-mouth, the depression in the steel industry being a large factor. There has also been a cessation of foreign buying for some time. Producers are only selling what conditions seem to justify and are not pressing the market nor offering future positions. Prime Western for early delivery is quoted at 4.65 to 4 7/10c., St. Louis, or 5.15 to 5.20c., New York.

ANTIMONY

This market is quiet with quotations ranging from 5.25 to 5.50c., duty paid, New York, for wholesale lots for early delivery. Jobbing lots are about 1c. per pound higher.

ALUMINUM

Virgin metal, 98 to 99% pure, is unchanged at 28c. per pound f.o.b. plant, from the leading maker with the same brand quoted by other sellers at 23 to 23.50c., New York. The United States Steel Corporation is reported to have bought a large quantity of foreign metal at lower prices than the above, but this rumor has not been confirmed.

ORES

Tungsten: Conditions are unchanged. There is no demand from consumers. Quotations are nominal at \$2.75 per unit for Chinese ore with other grades correspondingly higher.

Ferro-tungsten is nominal at 58c. per pound of contained tungsten in the lump form, guaranteed.

Molybdenum: Quietness prevails with quotations nominal around 50 to 60c. per pound of MoS₂ in regular concentrate.

Manganese: The market is easier with offerings of Indian ore at under 30c. per unit, seaboard. It is probable it can be bought at close to 25c. per unit.

Manganese-Iron Alloys: Demand for ferro-manganese is confined to small or carload lots. The American product has changed hands at \$90 per ton, delivered. While the British alloy is unchanged at \$100, seaboard, it is probable a desirable order would bring around \$85, seaboard, which is about equivalent to the American price. Spiegeleisen is stronger, one seller refusing orders under \$36, furnace. There are inquiries for small lots.

Ferro-silicon, 50%, is lower at \$90 to \$95 per ton, delivered. The Navy is taking bids on 200 tons. The electric 10 to 15% grade is selling at \$45 per ton, furnace.

Ferro-chrome, 4 to 8% carbon, is quoted at 16 to 16.50c. per pound of contained metal.

Ferro-vanadium is available at \$5 per pound of contained vanadium, with differentials up to \$6.50 to \$7, depending on the analysis and the quantity.



T. A. RICKARD. . . . Editor

FRANK A. VANDERLIP is of the opinion that "what we want is solvent, not insolvent, foreign customers". The increase of our gold holdings is more of a menace than a help to our commerce, for our national credit is so well established that more gold is of no further advantage to us.

THE shortage of copper in Poland recently became so acute that industries using that metal were obliged to suspend operations. The domestic production is negligible. The British government has now come forward, and an arrangement has been made whereby copper, zinc, antimony, and quicksilver will be supplied from English stocks. The Chilean government, as we noted recently, was negotiating for the sale, on credit terms, of 300,000 tons of nitrate yearly to Poland. Both England and Chile are acting wisely in helping Poland and themselves at the same time.

A "GAIN derived from capital, from labor, or from both combined, provided it be understood to include profits gained through sale or conversion of capital assets" is taxable income, according to an opinion just handed down by the U. S. Supreme Court sustaining the Collector of Internal Revenue. In one of a number of cases involving this issue, Mr. D. M. Goodrich sought to recover the amount of a tax paid on \$13,236, representing the increment in the value of 1000 shares of mining stock that he had purchased for \$500 in 1912, that were worth on the market \$695 in 1913, and that he sold in 1916 for \$13,931. It was argued that the appreciation in value was an increment of capital as distinguished from income; and that accordingly it was not taxable. The tax on the increased value accruing since 1913 and realized by the sale was held to be valid.

THE adoption and success of many excellent innovations has resulted from the need for the practice of economy, which, since the war period, has been looked upon as a praiseworthy exhibition of initiative, rather than as an unpleasant evidence of poverty. The disaster to the Alaska Treadwell mines in 1916 suggested the utilization of some of the surplus water-power, as electric current, for the cheap production of steel castings. The work was taken in hand as soon as a furnace could be obtained and with happy results, as described in an article by Mr. W. E. Cahill in this issue. Technical and economic success was the outcome of this innovation, a

conclusion confirmed by statistics; for 1,434,733 pounds of castings was produced during 1920, an increase of 71% over the previous year's efforts in this direction. Modifications in the method of operation were made as the work proceeded. Mr. Cahill gives the details, which should prove interesting to many of our readers.

A WARNING has been issued by the Associated Petroleum Engineers, through its chief geologist, Mr. Frederick G. Clapp, against any undue haste on the part of oil prospectors to act on the news of the discovery of oil near Fort Norman, in the Mackenzie district of the far North-West of Canada. The locality is 1200 miles from the nearest railroad and less than 300 miles from the Arctic Ocean; the press reports are unduly optimistic; geological conditions are unfavorable. Oil prospectors would do well to remember the result of the rush to Calgary, Alberta, a few years ago.

THAT the Pittman Act will not be repealed is the positive assurance with which Senator Key Pittman greeted his constituents upon his return to Tonopah from Washington last week. The Senator stated frankly that if it became necessary he and his confreres from the other Western States would conduct a filibuster to kill any legislation aiming to repeal the Act. He declared that there were four senators, including himself, who would speak six hours per day for a year, if need be, to forestall a repeal. He took the attitude that the Government had actually pledged its honor to the silver producers, and he felt certain that the present agitation would never gain sufficient headway among the Senators to make drastic action necessary.

UNTIL recently gold bricks have always been a readily salable commodity—occasionally even when they contained no gold, although in that case bargain prices were generally necessary to consummate a transaction. However, the officials of the U. S. Assay Office at New York lately have become suspicious of bricks that are unquestionably 1000 fine. The reason for this unusual scepticism is the belief that gold of Bolshevik origin is being imported. Gold bullion that has not the benefit of distinguishing stamps, such as those imprinted by the Swedish, the Indian, or the Canadian mints, must be accompanied by the following affidavit from the vending bank when presented at the Assay Office: "The undersigned owner of a lot of gold for the purpose of inducing

the United States to purchase said gold delivered to the United States Assay Office does hereby represent and warrant that said gold is not of Bolshevik origin and has never been in possession of the so-called Bolshevik government of Russia. The undersigned further represents that it is acting on its own behalf and not for the account of another in offering said gold to the United States, and does forever warrant to the United States without any qualifications and reservations the title of said gold. Apparently Bolshevism is as strong as aqua regia.

TO a great many will come a sense of personal loss in the passing of John Burroughs, the naturalist. Although not profound in his researches he attracted a number of those who appreciated a character that was marked by that gentility and sincerity which are common among our less materialistic investigators. For a number of years he had contributed to the daily press, his notes on nature being read by millions. But, unfortunately for him, such literary work is bereft of criticism. Burroughs became over-confident; he overlooked the credulity and laziness of the average newspaper audience. In August of last year he contributed an article to the 'Atlantic Monthly', in which he said that Darwin had 'already been shorn of his selective doctrines as completely as Sampson was shorn of his locks'. On the contrary, Darwin's brilliant conception of the evolution of man remains unshaken; his 'Origin of Species' is a classic that has withstood the onslaughts of clerics and laymen; his contentions are supported by practically every biologist of note, all the more enthusiastically because his conclusions have been subjected to exhaustive criticism and dissection. Darwinism is stronger today than it has been since that great naturalist, after twenty years of patient search for the truth, gave the world the only logical theory of the evolution of plants and animals.

WE have occasionally succumbed to the temptation to comment on ridiculous statements regarding extraordinary opportunities for investing a few spare dollars in mining ventures. In a recent issue of the San Francisco 'Chronicle' there appears an advertisement that includes a facsimile letter written by a "mining consulting engineer", so the letter-head informs us, named I. Murray Bailey, who has examined at least one end of the advertiser's mine in the Mother Lode region. Some of Mr. Bailey's statements are so 'good' as to defy comment; we quote verbatim, confident that the reader can extract a smile from every line: "Understanding flattering developments, not seen by me, have been made at the other end of the mine, which added to what is shown at the 450 ft. shaft, totals an extensive enhancement of values thus far demonstrated. I advise most strenuously a deep exploitation of these huge vein systems. My confidence in this urgent advice is not only based on present remarkable showings, but on these factual considerations:—the formation of the enclosing wall rocks are the regular typical prevailing well known talcose chloritic and magnesian slates; diorites, diabase tuffs, and amphibolite schists, in which strata are found the great mines which

have produced and are producing their millions of dollars in gold bullion and profit paying dividends, many of which mines are working at nearly one mile in depth and have their richest ores at this depth. So again I advise you to mine deep for I can confidently predict that with increasing depth you will find ever increasing riches."

DURING the past week we had the pleasure of listening to a speech by Major-General Leonard Wood, who was the guest of the Commonwealth Club of this city. The bluntness and the sureness of his opinions was delightful; one felt that a real man was behind them. We need no more hyphenated citizens, he insisted. The American mortar needs more cement, it already has all the sand it can carry. The test of suitability of immigrants is whether or not they can be assimilated successfully. We want to build up Americans, not Irish-Americans, nor German-Americans, nor English-Americans. The present is not a time when we can afford to lag behind in national matters because the War is over. The story was told of a colored soldier, who, as soon as the Armistice was declared, expected to be sent home. "Looka hyah, boss," he protested, "ah listed mahself fo' de duration of de wah. De wah am ovah". To which the officer, also colored, replied: "Maybe so de wah am ovah, but de duration's jus' begun". National preparedness must be preached. The youth of America would benefit in every way from a period of six months intensive training between the ages, say, of 18 and 21. He asked a German officer what he thought of the British officers. "Brave blunderers", was the reply. "Gallant and brave blunderers". We, too, lost men and money because we were unprepared, even after years of warning. Our officers had to be sent to the front after only three months of training, in many cases. We were seriously handicapped; but, thanks to Allied expenditures in this country for the construction of immense munition plants prior to 1917, thanks to Allied help with guns, aeroplanes, clothing, and equipment, and thanks to the fact that we could rely on Great Britain to transport 65% of our troops across the Atlantic, the delays and setbacks were not more serious than they were. War is inevitable to the unprepared. Had we been ready in 1914, as we should be now, there would have been no war. We have the resources; but in a crisis, and unless we are prepared for any eventualities, they would be as useless as would be an undeveloped gold mine in a Wall-Street panic. General Wood left for the Philippines on April 10. We wish him a pleasant voyage, success in his mission, and a speedy return.

A DISPATCH from Washington reports a convention of delegates representing 5000 members of the International Federation of Technical Engineers, Draftsmen, and Architects—an organization, we are informed, that was a direct result of the policy of the Railroad Labor Board to ignore this class of employees when awarding increases in wages. The union—the members, with commendable candor, call it a union instead of camouflaging its purpose by some other term—is affiliated with the

American Federation of Labor. The president is quoted as saying: "The 'white collar' man has to wake up to the fact that only through organized effort and union tactics can he hope to secure equal material advantages and working conditions with the mechanic and the carpenter. We are working to evolve some progressive system of arriving at equitable pay for our calling, based on the cost of living and certain other variable factors. It is lamentable that in the fixing of wages no research has ever been attempted to establish a scientific wage-standard." Apropos of practical operation of the regulations established by the Labor Board while the railroads were under Federal control, the following illustration is illuminating. A mechanic who works nine hours and nine minutes repairing a locomotive must, according to the established rules, be paid for $14\frac{1}{2}$ hours of work at his regular hourly rate. For the first hour beyond the standard eight-hour period he is allowed pay for $1\frac{1}{2}$ hours; for any further time he is entitled to 'call time' for which he is paid at five times his regular rate, the theory being that he should be compensated for any interference with his recreation. Any fractional part of an hour must be considered as a full hour in calculating his wage. This is not an infrequent occurrence; it happens repeatedly, although the railroads are making strenuous efforts to be relieved of these and similarly unreasonable provisions. They deserve to be. The significant point, however, is that such regulations never would have existed had it not been for the insistence of the powerful labor-unions. The attitude of the engineers and draftsmen is entirely intelligible; from some points of view it is unfortunate that they have been driven to organize a union, but they certainly have had a concrete demonstration of the power of concerted action as compared with the result of an impotence that is due to lack of organization.

Karl Eilers v. Guggenheims

At the annual meeting of the American Smelting & Refining Company, held at Jersey City on April 6, the nominees of the Guggenheim family were elected to the board of directors in the face of opposition from Mr. Eilers and his friends. Seven new directors were elected, namely, Messrs. Merrill P. Callaway, F. J. Leary, Benjamin Joy, Frederiek T. Walker, Lyman Candee, Wilfred Shore, and E. C. Jameson, in place of Messrs. W. M. Drury, L. G. Eakins, Isaac Guggenheim, W. E. Merriss, Edgar R. Reets, H. R. Wagner, and Herbert W. York. Mr. F. H. Brownell, senior vice-president of the company, presided, although Mr. Simon Guggenheim, the president, was in attendance. Mr. Brownell explained that Mr. Guggenheim felt that it would be less embarrassing to all concerned if the chair were occupied by someone else. After the reading of the minutes, Mr. H. B. Leary, representing the Eilers group, offered a motion to adjourn the meeting until the first Wednesday of October in order to allow time for an investigation and report by a committee of shareholders. In making his motion Mr. Leary took the opportunity to re-state the charges previously made against the Guggenheim management, so

that they became a part of the minutes of the meeting. After some desultory discussion this motion was defeated by a vote of 602,706 shares against 202,479, out of a possible 1,150,000. This, of course, was a test of the strength of the contending parties, but it indicated also that 344,815 shares were not voted. The election of directors followed, the entire Guggenheim ticket being elected. After the order to start balloting had been adopted, it was decided to adjourn to St. Peter's Hall, two blocks away, in order to get sufficient room, the crowd having overflowed the small quarters at 15 Exchange Place. As soon as the meeting was settled in its new quarters, Mr. Solomon R. Guggenheim read the answer of the management to the charges made by Mr. Eilers and his friends. After that there was little discussion, the majority of those present being in sympathy with the dominant interest. The Eilers faction was snowed under. A short speech was made by Mr. Robert Rumsey, an attorney representing the Evans committee. This consists of Messrs. Henry Evans, Clarence H. Kelsey, Henry K. Pomroy, Willis D. Wood, and Henry Whiton. In a circular issued on March 24 these gentlemen stated that they had consented to act as a committee of investigation "at the request of a large number of stockholders". At the meeting, Mr. Rumsey said that it was not the intention of this committee to ally itself with either side but to get at the facts independently. Mr. Brownell, speaking for the Guggenheims, replied that the directors would be glad to assist the Evans committee in every way. After the meeting Mr. Eilers signified his intention of continuing the campaign to oust the Guggenheims from the management and expressed satisfaction at the increased support given to the opposition. He said: "We feel that the increase in the number of anti-Guggenheim proxies, from 7000 shares last year to more than 200,000 which are now positively against them, plus a greater number who refused to vote, is prophetic of even greater increase next year as the stockholders become more acquainted with, and alert to, the disastrous results of outside adverse control." We shall refer to this matter again, because it is one of paramount interest to those engaged in mining on this continent.

The Portland Convention

The third International Mining Convention, held at Portland last week, like its predecessors at Seattle and Vancouver, proved notably successful. The word 'international' is a trifle grandiose, if not misleading, for the Convention essentially is a meeting of Canadians and Americans in the North-West. Its circuit, so to speak, includes Alaska, British Columbia, Washington, Oregon, northern Idaho, and western Montana. The international boundary is ignored, except when the tariff question arises, and even then there is little reason for quarreling: for although a tariff on our side may close the market to the product of a Canadian mine, it will be found frequently that the owner of the mine is an American. Indeed, the delegates from the two sides of the unfortified frontier that separates, and unites, the two

English-speaking peoples of this continent have found it pleasant and profitable to convene annually, to compare notes, to exchange ideas, and to register kicks. The last of these performances is rendered articulate by the Resolutions Committee, which on this occasion succeeded in interpreting the sentiments of the Convention so well that every resolution was passed unanimously. On matters pertaining to Canadian legislation or government, the American delegates did not vote; similarly, on American domestic affairs our Canadian friends were silent. Among the resolutions was one commending "The proceeding of the Federal Trade Commission against the Minerals Separation North American Corporation". This "endorsed and approved the action of the American Mining Congress in supporting the Commission's proceedings" and pledged assistance to that body in the effort to "remove what constitutes a serious and lasting menace to the mining industry". Another resolution called upon the Federal Trade Commission to pay its compliments to the so-called Powder Trust, and invited Congress to consider the excessive prices levied by the Trust for explosives, thereby burdening the mining industry and hindering "the great highway-building campaign being carried out in the Western States". A plea was made for a reduction in railroad rates. The Enlarged Homestead Grazing Act was voted as highly detrimental to the miner, and a demand was made for its repeal. Blue-Sky legislation of an extreme kind was deprecated in a resolution that advocated "standardization" of such laws, with a view to permitting men "engaged in legitimate constructive effort to seek aid in any State of the Union untrammelled by repressive laws which operate to retard development of the mineral resources of the West". This resolution specifically condemned the Kenyon Bill. The McFadden Bill was endorsed; likewise the Pittman Act. In regard to the latter it was resolved "that public attention be called to the fact that the price of silver produced in the United States has been stabilized by operation of the Act to the benefit of all metal-mining operations of the West and without burden upon the people by special taxes or bonus". As regards tariffs, those on lead and zinc, magnesite, and mercury were specifically advocated. A tariff of two cents per pound on lead was suggested; for zinc, the recommendations of the American Zinc Institute were approved. The Idaho Mining Association and the American Mining Congress separately received complimentary recognition. These resolutions are worthy of record as showing what the miner of the North-West wants or approves. The papers and discussions dealt more fully with the mining industry of British Columbia, notably in relation to iron and steel. Mr. C. E. Williams, of Seattle, reviewed the chances of producing iron and steel on the Coast, his excellent resumé being followed by a speech in which Mr. Nichol Thompson, of Vancouver, contributed the results of his own recent investigations. Mr. A. W. Martin, of Chicago, described the iron resources of Columbia county, Oregon, and Mr. Bradley Stoughton read a paper on the charcoal smelting of iron. The meeting was attended by

the President as well as the Secretary of the American Institute of Mining and Metallurgical Engineers. Mr. Edwin Landlow delivered a pithy address on 'The Mining Industry in Relation to Business Prosperity'. He deprecated tariff barriers and advocated an effort to stimulate foreign trade, as the best remedy for industrial depression. British Columbia was represented by Mr. William Sloan, the deservedly popular Minister of Mines, who gave an interesting sketch of the mining industry of the Province. Mr. S. S. Fowler spoke similarly for the Kootenai and Slooan regions; Mr. J. W. Mulholland, of the 'B. C. Prospectors Protective Association', discussed the 'Problems of the Prospector'. Mr. Robert N. Bell described the mineral resources of the Snake River country, and Mr. D. C. Livingston those of the Seven Devils district. The coal measures of the North-West formed the subject of a group of papers, by Messrs. George Watkin Evans, S. H. Green, and E. R. McMillan. Mr. Fletcher Hamilton, State Mineralogist of California, spoke for the McFadden Bill and Mr. Falcon Joslin voiced the pressing needs of Alaska. Mr. Sidney Norman, editor of the 'Northwest Mining Truth', acted as chairman of the Resolutions Committee and also delivered an interesting address on 'Protection to the Promoter'. Mr. T. A. Rickard, of San Francisco, delivered an address on 'Prospecting'. Thus it will be seen that the subjects discussed and the men presenting them for discussion were representative of the mind and matter of the mining business in the North-West. Restraint was shown in the length of the various utterances, only one case of prolixity being noted, and that was disciplined, properly but courteously. About 700 delegates and visitors registered. As is usual, the burden and responsibility of making the preparation and arranging the proceedings of such a convention devolved upon one man, for personal leadership in these matters is essential. To Mr. Henry M. Parks, Director of the Oregon Bureau of Mines and Geology, is due the most hearty thanks for his services as Executive Chairman. The Convention was marked, as heretofore, by the hearty co-operation of the mining men from the two sides of the boundary, and again served to promote goodwill between the neighboring peoples. If it had done only that, it would have been worth while; but it did much more, for it distributed a considerable amount of trustworthy information on technical matters, and it served to promote that sharing of personal experience which is the chief purpose of all such gatherings. The next convention of this series is to be held in June of 1922, at Nelson, British Columbia.

Business Expansion Abroad

Persistent commercial expansion in the foreign field can only be secured by the adoption of honest business methods. We regret, sometimes, to see the results of intensive soliciting and publicity in a wrong direction, leading to disappointment on the part of the foreigner and a failure on the part of the home concern. The energetic salesman of a certain type often finds what he considers as easy prey in Latin-American countries; the

hook needs but very little bait to hide it. He talks a prospective customer into buying what is really unsuitable, he is satisfied with having placed the order, and realizes that he will never get another from the same source. He lives largely on commissions, and lets the morrow take care of itself. And so there is much conjecture at home as to why the business does not prosper. How was it that the European countries could build up a fine connection in South America, whereas so many of our merchants cannot retain their clientele? The answer is that American firms trading abroad usually do not look far enough ahead. We may assume that their goods are of a high class of workmanship; but that is not enough. There are degrees of honesty in marketing. The 'Far Eastern Review' recounts a story of a British house in the Straits Settlements that ordered a supply of lead pencils during the War. According to an anti-Japanese story-teller, when the pencils were received and after most of the stock was sold it was discovered that the "crafty Japanese had conserved their store of raw material by merely inserting small pieces of lead at each end of the wooden sticks. When complaint was made, the Japanese house wrote back suggesting that the purchaser had better examine the sample. This was done, when it was found that the sample, also, was minus the lead in the middle". The absurdity of this story is evident, because continued prosperity was never achieved, as our contemporary remarks, by dishonesty; and the tale was coupled with the name of a Japanese house that is one of the strongest and most successful in the world of commerce.

The best way to build up foreign trade is to make it 'stay put', as the saying is—to study the buyer; and this is what a large number of American firms do not do. We hear too much of super-organization, and we see too little of its ill effects. A daily chart of orders placed is no index of success or failure. A foreign commerce, like Rome, cannot be built in a day; and the only sort of customer worth having is the one who comes back for more. Salesmen should be given an adequate salary, plus a bonus in recognition of only that sort of effort which will be of lasting credit to the organization. Commissions on sales often encourage over-solicitation, unfair competition, and ultimate disappointment. Mutual satisfaction and the placing of repeat orders are the best indices of successful commercial expansion in the foreign field.

The Zinc Industry

Producers and smelters of zinc ore are virtually unanimous in their support of a tentative schedule of zinc tariffs providing a graduated specific duty to replace the existing *ad valorem* rates of 10% on all ores, and 15% on slabs, sheets, and dust. The proposed measure provides that ore containing less than 10% of zinc shall be admitted free (this is to exclude from taxation those lead-silver ores containing zinc that is not recovered); that ores with a zinc content ranging from 10 to 25% shall be subject to a tax of 1½ cents per pound on the contained zinc; and that a similar specific tax of 2 cents per pound

of zinc be imposed on richer ores. It is further provided that the import duty on slabs and pigs be fixed at 2½ cents per pound, with a still higher tax of 3¼ cents per pound on sheets, dust, and other semi-manufactured products. The arguments advanced in favor of these greatly increased rates may be summarized as follows: (a) the importance of zinc from a national viewpoint on account of its being an essential constituent of the alloy of which cartridges are made, (b) the unprecedented depression of the zinc industry in the United States owing to the existence of unsold stocks in the hands of smelting companies amounting to about 71,000 tons, which, together with 100,000 tons in Europe, makes a total that is equivalent to six months normal pre-war consumption in this country; (c) the immense capital investment in mining properties and smelting plants, and the large number of skilled employees, estimated at 50,000, engaged in the industry; (d) the comparatively high wages paid to workmen, these being from two to six times as high as those paid for the same kind of work in the principal zinc-producing countries of Europe; (e) the development since 1913, when the Underwood tariff act was passed, of improved metallurgic processes, including flotation, for concentrating complex ores, and electrolyte methods for producing slab zinc; (f) the potential ability of Mexico to produce cheap ore for European smelters, as well as cheap zinc for export into the United States; the exploitation of Mexico's oil resources to provide cheap fuel will be an important factor in the establishment of a large zinc-smelting industry in Mexico; and (g) the existing discount on foreign exchange, which, obviously, operates to the advantage of the exporter of any commodity that is shipped from Europe to the United States. The belief is expressed by those engaged in the industry that no important quantity of zinc can be produced in the United States under present conditions for less than 6½ cents per pound f.o.b. New York, and that, to provide for depletion, depreciation, and a reasonable profit, from 1½ to 2½ cents should be added to this amount.

There are three principal countries from which ruinous competition is feared. The first and most immediate is Germany, where the rate of production today is from 4000 to 6000 tons per month, according to the European correspondent of the American Zinc Institute. Germany, before the War, could produce for approximately 80% of the average American cost, and this difference is of course now multiplied manifold because of the current rate of exchange for German marks. Whether or not the foreign zinc that is being offered in New York at less than 5 cents, duty paid, is of German production is uncertain; but it is admitted that Germany is supplying the limited amount required for British consumption, thereby depressing quotations on the London Metal Exchange, and, indirectly, the price in New York. Germany at the present time is smelting her own low-grade ores, probably with poor metallurgic efficiency, and is relying upon the great disparity in exchange for her profit. On the other hand, when the value of the mark appreciates sufficiently she can afford to purchase much-

needed concentrates from Australia, Burma, Northern Africa, or, in the course of time, from Mexico. Germany, like the United States, has hitherto produced zinc in quantity approximately equal to her own requirements. It seems reasonable to anticipate that when normal industrial activity is resumed in Europe, she will absorb most of her own output unless exportation to the United States is sufficiently attractive to induce the construction of new plants. The fact that German influence at the moment is the most disconcerting factor in the world's market for zinc is accounted for entirely by depreciated exchange; a significant fact being that there is scarcely a retort in operation in the plants of either Belgium or England.

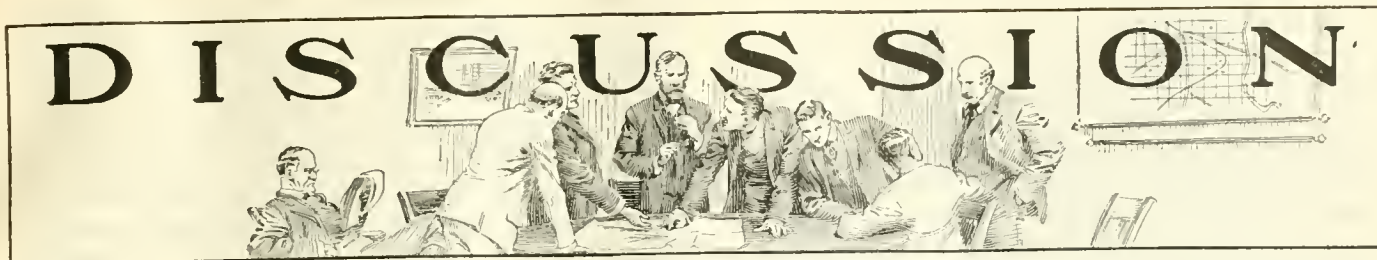
The second source of apprehension that disturbs the equanimity of the American producer is Tasmania, where, near Hobart, an electrolytic plant with an ultimate capacity of 40,000 tons per annum is partly constructed. Mr. W. H. Gepp, the manager, expects that substantial profit will be made, with zinc selling at £30, when the completed plant is operating at maximum capacity. Two of the ten proposed units, after being in service for some time, were recently shut-down for the reason that current operations were being conducted at a loss. At this distance the situation there seems almost identical with that existing at Great Falls, where the Anaconda Copper Company's electrolytic zinc plant ceased production in February. This plant has an annual capacity of from 50,000 to 60,000 tons; the power is hydro-electric, and the distances from Butte and other sources of ore-supply are comparatively short. Moreover, the cost of labor in Montana differs little from that in Tasmania and at Broken Hill, where most of the concentrate for the works at Hobart originates. Both enterprises enjoy efficient management, so that the cost attained in Tasmania ought to be approximately duplicated at Great Falls. This comparison, of course, would not hold in considering the coal-fired smelters in the Mississippi valley, where most of our zinc ore is treated. Since 1913 new plants of this type, and with an annual capacity of 126,000 tons, have been completed at an approximate cost of at least \$10,000,000. The investment represented by these new smelters as well as by the older ones cannot be ignored in fixing the tariff.

With respect to Mexico an immediate difficulty arises from the importation of ore mined cheaply by peon labor. Mr. Otto Ruhl, of Joplin, gives a comparison based on the costs of 11 representative plants in the Tri-State zinc-mining district, and on data obtained from the Bureau of Commerce as to the value of all zinc ores and concentrates imported during the past two years. His calculations show that the difference in cost to the producer in Joplin and to the importer at the port of entry is equivalent to 2 cents per pound on the contained zinc. Either through inadvertence or design, Mr. Ruhl ignores one point which seems to us important: the imported concentrate averaged only 34% zinc, whereas that from the Joplin district contained 60%. Accordingly the importer had $1\frac{1}{3}$ tons of material on which to pay freight

and smelter charges, as against only 1 ton for his competitor, even though the same amount of contained zinc had cost him 2 cents per pound less. The advantage of having a richer concentrate is obvious, but Mr. Ruhl has taken no account of it. A small zinc smelter has already been established in Mexico, at Saltillo, where oil provides an economical fuel. The assurance of stable conditions in Mexico will doubtless stimulate zinc mining, for the existence of extensive deposits of zinc ore awaiting exploitation is well known. Increased freight-rates on ore shipped to the United States, in conjunction with more general development of oil resources and the low wage of Mexican labor, ought logically to result in the construction of zinc smelters, the output of which would no doubt come preferably to this country. In our opinion the probability of serious detrimental competition, in respect of both ores and zinc slabs, is greater from Mexico than from any other country, although some years will be required to develop the mines and build the plants.

Outside the United States, Burma is the only other notable source of zinc concentrate. The Burma Corporation is building a small retort zinc smelter near Calcutta with an annual capacity of 10,000 tons of concentrate; but the greater part of the output from the famous Bawdwin mine will probably go to Europe. Negotiations are said to be pending whereby the Burma Corporation will utilize the immense smelter almost completed as a British war enterprise by the National Smelting Company at Avonmouth. Unless some such arrangement is consummated it is doubtful whether the Avonmouth plant ever will operate; the concentrate from Burma will then go to Belgian and perhaps to German smelters. The Burma company has hitherto shipped only a negligible amount of zinc concentrate, so that whatever quantity may be produced hereafter will represent an additional amount to be absorbed by the world's market.

Nevertheless, we are inclined to take a more optimistic view than do the zinc producers themselves. All industry is for the moment lifeless; the market is stagnant, and the condition is aggravated by the excessive stocks that have accumulated since the War. But with the certain renewal of general industrial activity and the absorption of excess stocks the price for zinc must improve. The producer of zinc is entitled to the protection afforded by a reasonable tariff; he will need it more especially to meet competition from Mexico; but he must realize that on broad principles the need for a protective tariff is eclipsed by the need for the re-appreciation of the currency of our customers, and that as a creditor nation our welfare depends upon the prosperity of our debtors. The tariff problem is so intricate that it is difficult to foretell the result of any schedule; nor can anyone accurately determine a scientific duty on zinc and zinc ores. We suggest, however, that the mining and smelting companies will serve their own ultimate interests best if they concentrate their efforts toward obtaining a reasonable degree of protection without seeking to justify a tariff wall that would entirely prohibit the importation of foreign zinc.



The Panama Tolls

The Editor:

Sir—The editorial in a recent number of your paper is complete and interesting; but, after all, the matter simmers down to a matter of sentiment and a little book-keeping. Americans would feel better if their right to use their own canal were unquestioned, but as a practical matter Congress could say that any American paying toll could have the toll refunded. This would be a subsidy but would be lawful, and it is difficult to see what the English government would gain by insisting on a claim that does them no good.

II. W. REED.

Salt Lake City, March 26.

[To do so would be an evasion, and might lead to friction. The spirit, as well as the letter, of an agreement should be observed.—EDITOR.]

The Editor:

Sir—While of no more interest to mining men than to every citizen of the United States, you are to be congratulated upon setting forth in detail, in your editorial of March 19, those points bearing upon the propriety or impropriety of American vessels paying tolls when passing through the Panama Canal. It appears to me that the language used in defining our obligations to Great Britain and the rest of the world is perfectly clear, and that all vessels, irrespective of their flags and destinations, must, according to that agreement, pay equal tonnage-tolls. It requires an elastic conscience and a flexible mind to read the agreement and draw the conclusion that the American flag means a free passage.

Whether it is wise that American bottoms should carry their freight free of tolls, is quite another matter, and if it is, let us not imagine that we read between the lines words to the effect that American vessels were excepted, but come out openly and say that we made a mistake and now ask for a new treaty for which we are willing to give some 'quid pro quo'.

There is one point on which you do not dwell which, to my mind, is of importance, that is, the expenses of maintenance, operation, sinking fund, and interest. I have not seen detailed figures upon this subject, but from time to time the press has given the yearly operating cost and receipts from tolls. As I recall them, the operating costs have been slightly decreasing, while the income has been increasing, but has not yet equalled the operating expenses. It would add very much to your article if you could show the entire expenditures on capital account and

all other canal expenses year by year since it was opened for traffic. These would, no doubt, be impressive figures, showing that the American taxpayer is now paying a very large bonus on every ton of freight passing through the Canal under whatever flag.

The thought naturally follows: if the toll is removed from American vessels, will not the average taxpayer be assessed this additional amount without corresponding advantage? Would it not be more just to let this tax remain where it can be paid by those more particularly benefited by the transportation which is benefited,

We cannot expect the Canal to be regarded as strictly a commercial enterprise, paying reasonable interest on the investment, for many a long year if ever. The American taxpayer must bear the Canal burden for years to come, but it is not without compensation. The existence of the Canal makes for smaller naval appropriations and is of assistance to every line of American trade, thus indirectly benefiting all citizens. Instead of saying, "America pays the bill, therefore American shipping should pass through free", we should say, "America paid the bill for purposes of national safety and the advancement of national industry, both of which she is now receiving."

If only a proportion of the American merchant marine is to benefit by the proposed exemption (and that is about all I can see to it), it would be better to use the word 'subsidy' than 'exemption'.

America has been very loath to offer subsidies, but she can do this without breaking treaties. The financial result will be the same, while respect will not be diminished. It will not be pleasant to know that others think that we regard treaties as "scraps of paper".

New York, March 24.

F. F. SHARPLESS.

The Education of Engineers

The Editor:

Sir—In continuance of the discussion of a mining engineer's education: some of your readers will question the common assumption that technical proficiency as a matter of course has value in itself. I wish to suggest that technical proficiency has value only when supported by good mental habits. The engineer of bright mind and weak will, studious but vague, is indeed an unhappy object. And, however highly trained, he may have less ability in handling an engineering enterprise than a man of decision who has followed his university course in another direction altogether, such as that of law. Toward the

achievement of real work, he may count less than a self-respecting bricklayer.

Now, technical schools do not necessarily teach good mental habits. The plain fact is that they unwittingly teach bad mental habits. The very complexity of their appeals, the very variety of their wisdom, tends to crowd and to confuse the student and to draw him this way and that. Each lecture that is even a little 'too much' for him gives him one more impulse in the direction of incompleteness. He acquires a habit of mediocrity. During four pliant years he inhabits a community where few do their best work, where mild effort is respectable, and where the whole atmosphere is unbusinesslike. Little wonder that there is a shock in the change to a private engineering enterprise in which mediocrity calls out harsh disapproval from all sides!

This picture, even though drawn somewhat broadly, still carries plenty of truth. For the value of the four years' course may often be more than neutralized by the disorder of mind which becomes a positive habit—a habit, once the pliant years are passed, to be unlearned only through grim effort.

The point that I wish especially to make is that a school may be intrinsically less significant for the subjects it teaches than for the way these subjects are taught. If, as is rarely the case, the school should watch students not so much to see that they get correct answers as to see *how* they get answers at all; if it should say to the young man, "Your notes, your desk, and the words you utter are indexes of your character. My chief purpose is to seek and kill the weaknesses there revealed"; then the school would furnish a more fundamental tuition. It then would teach not so much specific thoughts as good methods of thought; and the student, equipped with good methods of thought, would be equipped to acquire the specific knowledge he needed; he could go after it and get it. Whatever he had studied, and whatever he understood, he would have a good chance for success.

I am, therefore, less interested in the question of 'cultural' tendencies in education than in the need for a teaching of good mental habits. That schools fail to develop such habits is no one's fault. But there seems to me an excellent chance for schools to undertake a gradual and notable improvement by turning their attention to this matter. A few simply stated precepts,* learned thoroughly and incorporated in the character by practice, might be more valuable than an average university education. It is conceivable that we will some time have important schools that will undertake to teach nothing else.

San Francisco, March 29.

AUGUSTUS LOCKE.

Oxy-Acetylene Welding and Cutting

The Editor:

Sir—In the 'Press' of March 26, I note with much interest a valuable article on oxy-acetylene welding and cutting at Anaconda by Thomas W. Cunningham, and an

*Such as that of William James: "Seize the very first possible opportunity to act on any resolution you make . . ."

editorial on the same subject. The value of oxygen to mining and industrial operations is only beginning to be realized. There are many mines and prospects that are not in a position to supply themselves with the expensive equipment that is possible with a company like the Anaconda, yet they need not be deprived of the benefits obtainable with the oxygen blow-pipe. Oxygen can be purchased in steel cylinders, just like acetylene, prestolite, or hydrogen; for cutting, there are other fuels that will perform the same function as acetylene. For welding, the acetylene has been found the most convenient and best gas to use with oxygen. The welding process is in reality a casting process. The two edges to be welded together are heated until they are melted; and a rod of the same metal is melted and allowed to run into the crack between the two edges that are to be joined. The melted edges and the melted rod thus run together, forming one continuous piece. In this process the iron or steel must not be burnt. The heat of the flame must be above the melting point of the metal, with no excess oxygen, or, as we say, it must be a reducing flame. This is obtained easier with acetylene than with other gases, and requires a torch or blow-pipe that is carefully designed. For cutting steel, burning a hole in it, brazing, soldering, babbitt-melting, tool tempering, shrinking, pipe bending, and other similar purposes, there are a number of fuels that will answer equally well.

In the event of inability to procure good acetylene, no attempt should be made to make it from carbide in a home-made generator, as it is a dangerous gas; prestolite, hydrogen, city gas, natural gas, or even gasoline, kerosene, distillate, benzine, alcohol, will serve the purpose (except for welding). For cutting rails, bars, and sheet-steel, an improvised oxygen tip can be made from a piece of $\frac{1}{4}$ -in. pipe (preferably copper pipe) by closing the end, and then by drilling a $\frac{3}{16}$ -in. hole in the closed end. Oxygen will neither explode nor burn by itself; a jet of oxygen can be forced or blown through a flame of an acetylene torch or any other neutral gas flame without burning or igniting. To use this improvised oxygen jet, the rail or bar to be cut can be laid on a couple of rocks or pieces of metal away from wooden floors. An ordinary gasoline blow-torch is then used, so that its flame is directed against the bar at the place where it is to be cut. When the bar is red hot, direct the fine oxygen jet against the metal at the point where it is to be cut, without removing the gasoline torch, which is left burning to keep the steel hot while the cutting is being done. The steel becomes a fuel and burns to an iron oxide by combining with the oxygen. The gasoline torch simply keeps the heat to the point of kindling the iron, and the oxygen burns it. This will suffice for an emergency job, which can be accomplished in a very few minutes. In case the gasoline torch is not at hand the bar can be heated over an ordinary blacksmith forge; it can then be pulled out of the fire and the oxygen jet directed against the spot. As long as the iron is red the oxygen will burn it. In case the bar cools before the cutting is finished, it can be put back in the fire and the operation repeated. This is not so efficient as cutting with a complete equipment but

it will often save time. If a smooth cut is not essential, compressed air can be made to take the place of oxygen; but the operation is much slower; the application is limited to small cuts; and the cooling effect of the expanding air makes it more difficult to maintain the heat in the metal above the point of kindling. If the plant is equipped with an oxygen generator, the hydrogen is always a valuable fuel gas to be used around a mine, in the kitchen, blacksmith-shop, machine-shop, or manager's office.

For a number of years, attempts have been made to use ground charcoal, coke, soot, and sawdust soaked in liquid oxygen, as an explosive to take the place of dynamite. The chemistry of the problem has already been worked out, and it is now only a question of economical mechanical appliances for producing it at the mine. The Germans used liquid-oxygen explosives during the War, Georges Claude, of Paris, developed liquid-oxygen bombs, made from burnt cork, just at the close of the War, and it has been used in connection with several tunnel projects, with more or less success. The Bureau of Mines has made investigations of the German methods in the war zone, and experiments have been carried out with methods adapted from information obtained from the War. Information thus far obtained indicates that ground carbon, with liquid oxygen, has about twice the explosive force of dynamite, weight for weight. It appears to be possible that any mine can now produce its own explosives. There need be no powder-house, no danger of explosions, no money invested in powder supply, no shipping delays, no deterioration of the supply, no half-burnt sticks of powder on the dump, no powder getting under the stamps, and no stock on hand for I. W. W. or radicals to steal. Perhaps the investigations will some day lead us to use the sawdust and chips from the timber-framing shop for blasting the ore.

Gunpowder, and explosives of that kind, can be exploded (combusted) under water and in closed places, because all the products needed for their combustion are contained within the mass. The expansion of the gases of rapid combustion is the force of the explosion. Finely ground carbon, put into a waxed paper cartridge, would look exactly like a stick of dynamite, and would be perfectly harmless till dipped in liquid oxygen. Then the carbon has all the products needed for its combustion within the cartridge; if ignited it will almost instantly be consumed; the instantaneous combustion throughout the mass is called an explosion. The expanding gases of carbon and oxygen combustion will function the same as the gases from exploded gunpowder or dynamite. Oxygen can be made as required. It can be carried in steel thermos bottles, into which the carbon cartridges can be dipped, just before being thrust into the hole. As long as the carbon cartridge and the liquid oxygen are kept apart, both are safe, when mixed it can be detonated and ignited. If allowed to stand the oxygen will evaporate, and the carbon will become harmless till dipped again.

The present methods of making liquid oxygen from liquid air were developed by Carle Linde, of Munich, and Georges Claude, of Paris. The mechanical equipment is

different but the principle is the same. It will be noted, from the following table, that nitrogen stays in a gaseous form to a lower temperature than oxygen does. Therefore if air is chilled to a temperature of -194°F . both the nitrogen and the oxygen are liquid. If the temperature is raised above -194°F ., say to -185°F ., the nitrogen reverts to a gas and passes off, whereas the oxygen remains liquid, like water.

Physical Properties of Air, Oxygen, and Nitrogen

	Boiling point	Critical temperatures	Critical pressures in atmospheres	Pounds per square inch
Air	-191°F .	-312°F .	39	575
Oxygen	-181°F .	-295°F .	51	750
Nitrogen	-194°F .	-317°F .	39	515

The air is compressed and cooled; a portion of it is then expanded to cool still further the remaining portion until it is cooled below the critical temperature -312°F . (344°F . below the freezing point of water). The liquid air is then slightly warmed; and the nitrogen, having a lower boiling point than the oxygen, is evaporated first and passes off, leaving the liquid air richer in oxygen. If the heat is continued long enough the nitrogen will nearly all be passed off as nitrogen gas, leaving the liquid air, practically liquid oxygen, containing from 95% to 98% of pure oxygen.

Oxygen thus obtained is not so pure as that obtained by the electrolysis of water, yet it is extensively used with a reasonable range of efficiency for nearly all purposes where electrolytic oxygen can be used. However, some experiments are now being made, in an effort to liquefy economically the purer electrolytic oxygen, by passing it through refrigerating or condenser tubes, chilled with compressed air.

LETSON BALLIET.

Oakland, California, March 31.

The Koering Process

The Editor:

Sir—In one of your late issues, I note with interest your derisive comment on the metallurgical work of my associate, Dr. Ben R. Koering, consulting engineer for the Lynn Big Six Mining Company. To one who assisted in that work continuously since last October, your comment is slightly irritating, but after careful consideration, I do not believe that it necessitates a reply.

For your enlightenment, however, I will state that the Lynn mining district has been examined and reported upon by at least a dozen eminent mining engineers and geologists during the past fifteen years, and all agreed that the possibilities were unfavorable for the development of a paying mine. While making screen-tests on the ores of the Lynn Big Six, Dr. Koering and Mr. H. L. Parker, superintendent, noted the unreliability of fire-assays. Samples were sent to some of the leading assaying firms of the West, and the results were equally satisfactory. An expensive laboratory equipment was immediately installed, and after some careful research work, in which I had the honor to assist, it was determined by Dr. Koering that the red stain which permeates this whole porphyry area, instead of being the common iron oxide stain, as previously supposed, is predomi-

nantly a mercury stain containing, in addition, gold, bismuth, tin, gallium, vanadium, uranium, and other rare metals.

A little test mill of 50 tons daily capacity was immediately erected, and the important fact is that, despite the erratic assays, we have determined by repeated tests, from different sections of our properties, that the entire area yields more gold per ton, by the simple amalgamation process, than the contemplated yield per ton of the Alaska Gold.

Another interesting fact is that during our tests, one miner, in two hours, with two sticks of powder broke over 300 tons of ore. From the concentrates obtained we have already made over twenty different pigments of the rare metals. Options have been taken on mining claims in the district during the last three months, to the extent of a quarter of a million dollars. In one case a substantial first payment was made.

I hereby extend to you a cordial invitation to visit our Camp, and see for yourself two of the world's greatest gold mines in the making, mines in which the gold will ultimately be but a by-product. During your visit our well-equipped laboratory will be entirely at your disposal, so that you may show us how to assay our "spirit ores", which I judge from the trend of your comment, will be a very simple matter for you to do. I assure you, Mr. Editor, that by so doing, you will render a signal service to the mining industry of this section, for which all of us will be grateful.

T. F. O'BRIEN.

Asst. Supt., Lynn Big Six Min. Co.

Carlin, Nevada, April 3.

[We are glad to give Mr. O'Brien an opportunity to reply to our recent comment. If the facts prove to be as stated, we shall avail ourselves of the first opportunity to visit this remarkable mining district.—EDITOR.]

Valuing Partly Exhausted Mines

The Editor:

Sir—In your editorial of April 9 on my article which appeared in the same issue you criticize my attitude where I refer to previous writings by Mr. J. H. Curle and Mr. M. H. Burnham. You say as follows: "We note his [Morton Webber's] reference to previous writers with whom perhaps we are better acquainted than he and of whose work we are more appreciative."

In respect to your first statement I have no objection to offer, but I strongly object to your second assertion: "and of whose work we ['M. & S. P.'] are more appreciative". This is an unsupported assumption and calculated to create ill feeling between Mr. Curle and myself; a senior for whom I have the greatest respect. I also feel you assume a knowledge approaching divinity in advising your readers what is in my mind; and suggest for your consideration that many of us find it expedient to submerge our thoughts in a good deal of obscurity.

I will now proceed to show that you are human and err like your friends. In the 'M. & S. P.' of October 19,

1912, in referring to Mr. Curle's work I state as follows: "One method of life extension appraisal was emphasized several years ago by J. H. Curle. The net profit of ore reserves was estimated to represent from 65 to 80% of the total valuation. The remainder was allocated to life extension. The proportion allocated substantially depends on the condition of the bottom levels. In this way the possibilities are compounded by formula with the known ore of a mine. This basis of appraisal is still popular with many engineers. In my judgment it is illogical and as likely to overvalue possibilities as to be conservative. Mr. Curle's system has been, however, of great value. It teaches the investor to always consider mining from the business-like standpoint of assets. Its defect is that the relative magnitude of the ore reserve in any particular mine is largely a matter of administrative policy. A small mill in combination with an energetic policy of development will result in a mine maintaining a large ore reserve. A large mill in combination with an ordinary development policy will not permit of a large ore reserve. The same mine might be developed down to the same horizon under different administrative policies and exhibit identical evidence of permanence. Therefore any method of appraisal that depends on formula would result in entirely different valuations of the same bottom, or lateral extension, as the case may be. Such a method of valuation disregards the primary basis on which the appraisal of life extension should rest, namely, geological evidence. It disregards the widely varying geologic nature of different mines, and it ignores the important collateral evidence supplied by adjacent properties. The prognosis of life extension should rest on how far ore-shoots may be expected to extend beyond the limits of present development. It is illogical to vitiate this by introducing the transient factor of the remaining ore enclosed within development extremities." It is therefore clear that Mr. Curle's work is appreciated by me. It was necessary to be first destructive in my arguments before proceeding with constructive suggestions; but my attitude was none the less appreciative and it was quite impersonal.

In respect to Mr. Burnham's writings wherein you refer to them as "pioneer work" my views are different. I expressed myself ten years ago as being opposed to all formulae in valuing the future of mines in an article entitled 'Estimating and Valuing the Future of Mines' which appeared in the 'M. & S. P.' September 16, 1911. At that time you were editor of 'The Mining Magazine' of London. When Mr. Burnham's articles appeared, advocating the use of formulae for such a purpose, you asked me to write a criticism on Mr. Burnham's articles, which you later published in 'The Mining Magazine'. As Mr. Burnham's writings were not previous to mine and as our views were radically different I cannot see why I should regard him as one of my pioneers. I therefore desire to correct your error in fact concerning my attitude toward Mr. Curle and your dates in respect to Mr. Burnham.

MORTON WEBBER.

San Francisco, April 10.



THE STEAM-SHOVEL WORKINGS

Nevada Consolidated Copper Company—II

Steam-Shovel Mining

By Arthur B. Parsons

INTRODUCTION. In the early development of the Nevada Consolidated orebodies under the direction of F. W. Bradley and J. H. Mackenzie it became evident that there was one important difference between the Ruth ore deposit and that at Copper Flat, namely, the thickness of the overlying zone of leached porphyry varied from 40 to 100 ft. in the Copper Flat group, whereas the top of the ore-zone in the Ruth mine was from 120 to 500 ft. below the surface. As the work progressed and the extension and continuity of the ore in lateral directions, as well as the comparatively shallow depth of the enriched zone, became definitely established, the suitability of the deposit at Copper Flat for open-cut mining by steam-shovels, as done generally at the iron mines in the Lake Superior region, became evident. Mr. Bradley recognized the applicability of the method, and his conclusions were corroborated by J. Parke Channing when he examined the property in June 1904 and again in 1905.

The principal requirements of an orebody that is to be mined by steam-shovels are, obviously, an immense tonnage, large lateral extent, a thin overburden, and a comparative uniformity in the grade of the ore removed.

Among the less important considerations are the horizontal shape of the deposit, the structural character of the ore and of the overburden, and the topography of the surrounding country: upon this last will depend the advantageous arrangement of the approaches and the dumps for disposal of the waste cap material. With respect to all of these points, conditions at the Copper Flat mine were decidedly favorable for open-pit work.

In order to attack the ore in the most advantageous way it was first necessary to know with reasonable accuracy the shape and size of the entire deposit. This was learned by sinking churn-drill holes at intervals ranging from 20 to 200 ft. over the entire area. Prior to January 1, 1920, 301 such holes with an average depth of 300 ft. had been sunk, and further development work is in progress constantly. Complete assay-records of these holes are obtained by sampling the sludge from five-foot vertical sections. In addition, a composite sample representing the ore penetrated at each drilling is prepared. This is analyzed for iron, sulphur, and insoluble, in order to obtain data on which to base an estimate of metallurgic amenability. The approximate ratio

of concentration and the resulting cost of smelting have a bearing on the determination of what material can be mined profitably under varying conditions of operation. The method of operating the keystone churn-drills will be described in connection with the blast drilling.

More than a hundred prospect or development holes had been sunk prior to August 1907, when the first steam-shovels were put to work stripping on the area now occupied by the Eureka pit. By the spring of 1910 the Eureka pit was a bowl, 160 ft. deep, roughly oval in shape, and with maximum dimensions of about 1000 by 2000 ft.; five Bucyrus shovels were loading 8000 tons of ore daily for the mill at McGill, besides keeping stripping well in advance of mining. At that time there were four working-levels or terraces on one side of the pit and three on the other, whereas now there are nine.

In 1909, work was started on a second pit, known as the Liberty, about 1500 ft. west of the Eureka. The two were worked separately with distinct systems of tracks, entering on opposite sides of the Defender dump until 1916, when they were connected by removing the intervening ground. The result is a single large pit with the tracks and terraces both making continuous loops from one entrance to the other. This change made it possible to discard sundry spiral tracks and to diminish the maximum grade. For the benefit of readers unfamiliar with such work, the general plan of operations will be outlined briefly: The pit, as its name implies, is a long irregular amphitheatre with terraced sides. These terraces or benches, approximately 50 ft. wide and 50 ft. high, gradually recede at points where shovel-operations are in progress as the size of the pit is increased. The upper terraces, of course, must be enlarged first to permit progress on the lower ones. At the working-points the edges of the benches are blasted loose and a steam-shovel on the next lower bench, advancing in the direction of the contour, loads the loosened material into cars pulled by light steam-locomotives and running on standard railroad-tracks. The rails emerge from the pit at points of depression in the surrounding rim, finally reaching a common grade some distance from the pit. Ideally one or two of the uppermost benches would be in capping and all the lower ones would be in ore. Unfortunately the operation is not so simple: constant attention is required to separate ore and waste, as will be described later. The Nevada Consolidated pit is small as compared, for instance, with that of the Utah Copper mine at Bingham, Utah, where an entire mountain is being eaten away,* but it is, nevertheless, an interesting and unusual sight and cannot but impress the spectator with the magnitude of the engineering accomplishments of our day.

Steam-shovel mining may be considered as consisting of four principal operations, namely, breaking the ore or capping, loading it, transporting it, and disposing of the capping. Obviously, the economical and efficient handling of material is the principal problem. So far as

the mechanical operation is concerned, the stripping is not essentially different from mining, except that the valueless capping is transported by means of 20 cu. yd. side-dumping cars to the waste-dumps, the ore being loaded directly into standard railroad-cars to be hauled to the concentrator.

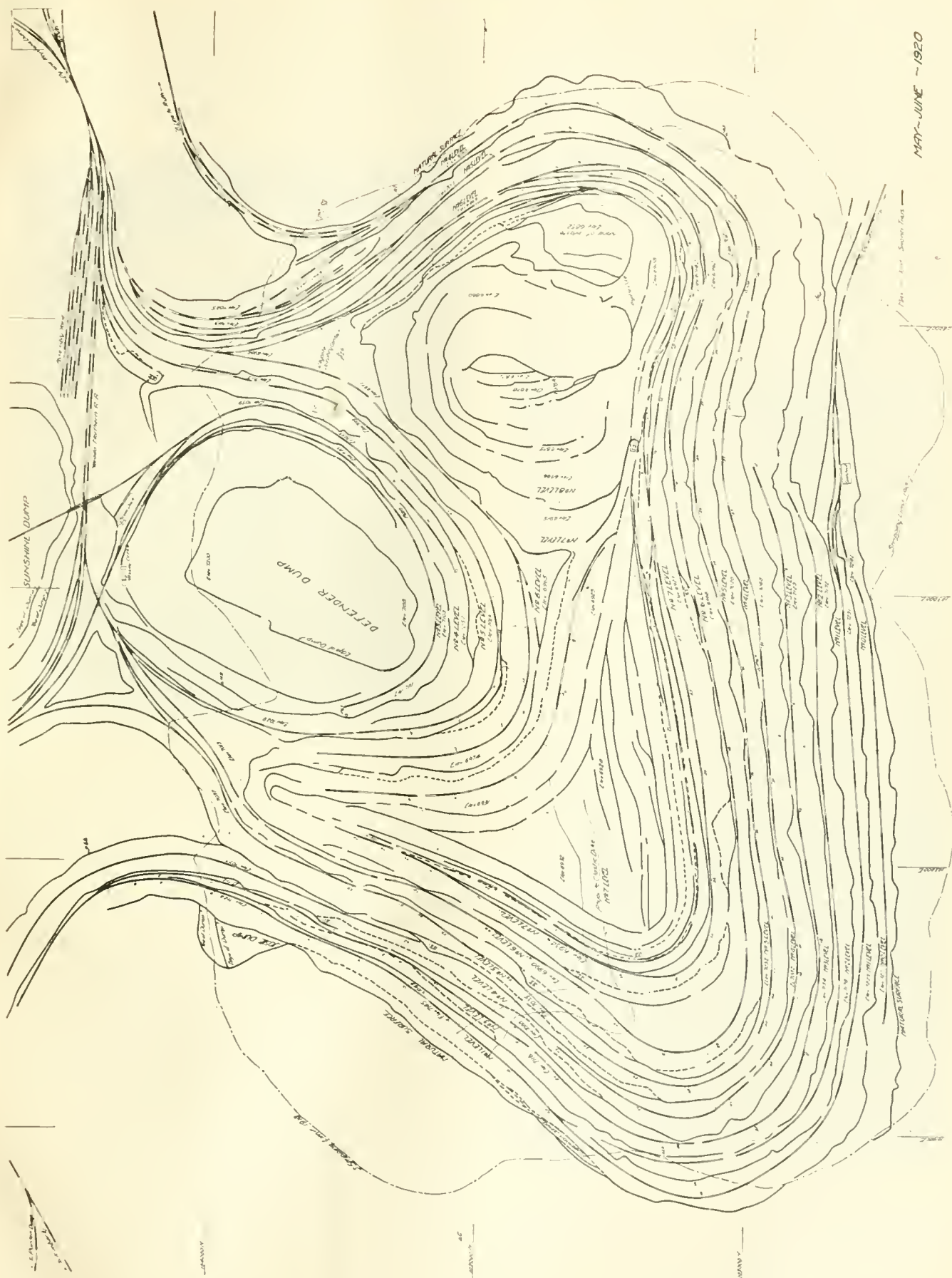
BREAKING. The object is to shatter the rock (for convenience I shall use 'rock' to include both ore and capping) sufficiently to enable the steam-shovel to pick it up readily. A certain amount of 'dollying' will be necessary to break large rocks, but it is desirable to reduce this to a minimum and thereby to avoid delay in the operation of the shovels. The Nevada Consolidated rock has the reputation of being unusually soft, and some of it is, but there are streaks of hard material mixed with the softer; F. E. Grant, superintendent of steam-shovel mines for the company, assures me that the breaking is not so easy as the kaolinized character of the rock seems to indicate it ought to be.

The blasting is done exclusively in six-inch churn-drill holes, bored from the bench above. These holes are necessarily vertical; usually they are 55 ft. deep, thus extending about five feet below the grade (assuming a 50-ft. bank) to assure the breaking at least to the level of the lower bench. This obviates difficulty with unbroken projections above the grade-level that interfere with the laying of track for the shovels and trains. The interval between holes varies with the character of the ground, but the average distance from the edge of the bank is 10 ft. and the space between holes is usually 35 feet.

The equipment comprises eleven No. 5 Keystone drills, with coal-fired boilers. This drill is strong, fast, and reliable; with a crew of two operators, that is, a runner and a tool-dresser, one 55-ft. hole per 8-hour shift is not an unusual average for experienced men. In prospect-drilling, after a depth of 150 or 200 ft. has been reached, progress is slower, of course; 15 ft. per 8-hr. shift is a good record. At the collar of the hole an 8-in. steel casing, 6 or 8 ft. long, is sometimes inserted, where the ground has been shattered for a few feet by the previous blasting. The casing also serves to guide the bit until a good start has been made; it may or may not be removed after the hole is complete. The average speed of the churn is from 50 to 60 drops per minute. A bailer made of 4-in. pipe-casing with a valve on the lower end is used to remove the sludge at intervals. Sometimes in hard ground it pays to bail with every foot of progress, but every two feet is generally often enough. In prospect or development holes the sludge is saved as a sample for assay.

Sundry advantages in the use of churn-drills as compared with tripod air-drills of the Burleigh type were pointed out to me by J. W. Foote, chief engineer for the steam-shovel operations. The principal economy is a saving in labor, because in using the churn-drill, no bank-trimmers are required; this also makes the work much safer; and the necessity for extending air-lines on all the benches is obviated. When air-drills are used, a series of

*T. A. Rickard: 'The Utah Copper Enterprise', 'M. & S. P.', October 19, 1918.



GENERAL MAP OF THE STEAM-SHOVEL MINE. THE ORIGINAL EUREKA PIT IS TO THE RIGHT, AND THE LIBERTY PIT TO THE LEFT OF THE DEFENDER DUMP

too holes in the face of the bank, as well as a vertical hole started on the bench above, are usually required.

At one property where steam-shovel mining is practised, both churn- and tripod-drills are used. This method might require somewhat less powder for the original blasting, but it is the belief at Ruth that, with the particular character of rock found in the Copper Flat pit, the saving would be more than offset by the additional labor required in re-blasting the large pieces, and the delay to the steam-shovels in loading. The local conditions and the type of cap rock and ore obviously are varying factors that determine the method that is in the end most economical.

All blasting is done by a special set of men in charge of the blasting-foreman. The first step is to 'chamber' or 'spring' the hole; that is, to make a pocket at the bottom to receive the blasting charge. This is done in three or more stages by detonating in succession increasingly large charges of low-freezing 40% powder: first 8 or 10 sticks, then a quarter of a box, three-quarters of a box, and, if necessary, two boxes are used. The success of the chambering can be determined by a simple contrivance consisting of a piece of bell-cord 60 ft. long, at the lower end of which is attached a cylindrical piece of wood of 4 in. diameter and 3 ft. long, centre-weighted with lead. This is used to sound the hole. Water serves for tamping; and, when the explosion takes place, a realistic imitation of a geyser ensues.

For the blasting-charge 300 to 700 lb. of powder is used, the quantity depending upon the nature of the ground and the burden on the hole. Since 1919 two-fifths of the total quantity used has been ammonia or nitro-starch detonating powders, between which there is no particular preference; and three-fifths has been ordinary black blasting-powder. Prior to that time a much larger proportion of the more expensive powder was used; but exhaustive comparative tests convinced the officials that the net cost of breaking was considerably lessened by the increased use of black powder. Some of the heavier sulphide ore requires that the stronger explosive be used exclusively; moreover, a small amount of detonating powder (approximately 2% of the charge) is used in each hole to make the explosion not only certain but as effective as possible.

The following data show the results of one competitive test, and indicate the comparative cost:

Kind of powder	Number of holes	Material (in place) broken cu. yd.	Powder used lb.	Cost of powder	
				per cu. yd. broken	per cu. vd. broken
Dynamite	41	97,391	47,516	0.488	0.0799
Black powder	41	102,454	59,555	0.552	0.0686

The following figures show the consumption of powder during the first six months of 1920:

Tons of ore and capping broken	3,601,682
Pounds of powder used	778,852
Pounds powder per thousand tons	216
Tons material per pound of powder	4.62
*Cost of powder per ton of material	0.03114
Total drilling-cost per ton material	0.00804
Labor cost of blasting per ton material	0.00496
Total cost of powder, drilling and blasting as above	0.04414

*Includes freight from B. & C. (Utah), Roberts (California), or Hercules (California).

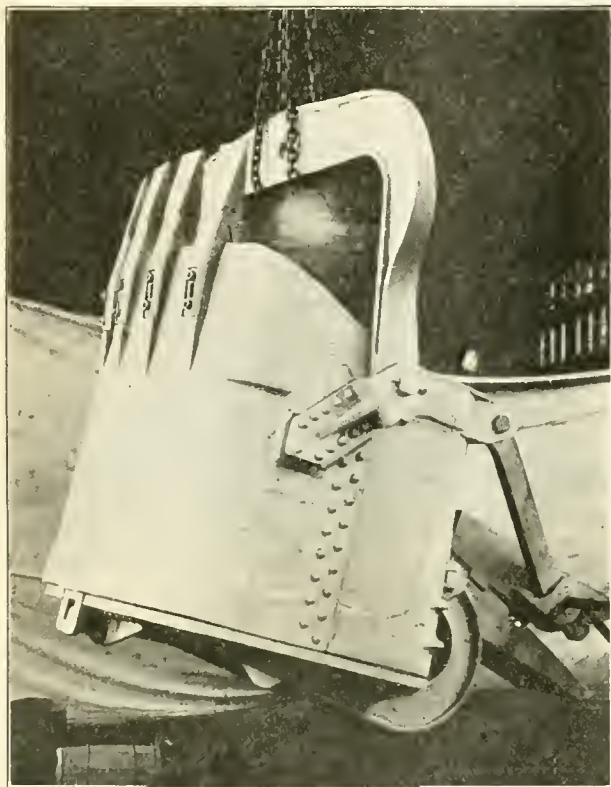
Mr. Grant is enthusiastic over the results obtained by

using Cordeau Bickford safety fuse for all the blasting. Ordinary water proof fuse with No. 6 caps was employed at the outset, but this was displaced by electric firing, using No. 8 exploders. Recently, however, Cordeau-Bickford detonating fuse has been used exclusively. It consists of a small lead tube filled with trinitrotoluene and carefully drawn to uniform size. It cannot be discharged by friction, fire, or ordinary shock; it is detonated only by means of an ordinary blasting-cap. The average rate of speed of the impulse is 17,500 ft. per second, so that when Cordeau is used, the explosion is practically instantaneous. Cordeau acts as a detonator, as well as a fuse, and no cap is used with the powder; the line of Cordeau functions as the detonator after it has once been 'exploded' by means of an ordinary cap or electric exploder, to which it is connected by means of a special brass sleeve. The advantages of this detonating fuse are: (1) Any number of holes can be detonated simultaneously by means of a single cap and an appropriate circuit of Cordeau. (2) By running Cordeau through the entire charge the speed of detonation is accelerated and the shattering effect of a given quantity of powder is increased, thus either permitting lighter charging or more effectively breaking the rock with the same charge. (3) Loading of holes can be done more quickly and with greater safety than when fuse and a detonating cap in a primer are employed in the usual way, and, moreover, the danger from unexploded caps and powder in missed holes is entirely avoided.

STEAM-SHOVEL LOADING. Nine steam-shovels are included in the equipment; all are of Bucyrus make. Five are 95-ton class C shovels with 3½-cu. yd. dippers, 25-ft. dipper-sticks, and 34-ft. booms. Originally these were built with 18-ft. sticks and 28-ft. booms, and carried 5-yd. buckets. In order to enable the shovel to take a wider cut, thereby reducing the shifting of track necessary, the sticks and booms were lengthened. The expectation was that the five-yard buckets could be retained, but it soon became evident that this was impracticable; so the smaller buckets were substituted. In addition, there are three 95-ton Class B, and one 70-ton Class B, shovels all fitted with 3½-cu. yd. buckets. All the shovels are operated by steam, and the boilers are fired with coal. Each is equipped with a one-kilowatt Schroder turbo-generator to supply direct current for lighting purposes. The crew actually engaged in the operation of the shovel consists of eight men, including one shovel-engineer, one crane-man, one fireman, one coal-passer, and four pit-men. The specific duty of the pit-men is to take up the track behind and to re-lay it ahead of the shovel as progress is made in the removal of the bank. They are, however, available for any work in connection with the shovel operations. During the first half of 1920 the average performance of all the shovels on ore was 306 tons per hour; the shovels on capping loaded 152.2 cu. yd. per hour during the same period. This includes the time consumed in moving the shovel and all lost time incidental to delays of the trains hauling the rock.

An important item of steam-shovel equipment is the

dipper. The Missabe dipper with the Vanderhoff front and points, made by the American Manganese Steel Co., is used at Ruth. E. E. Vanderhoff, when superintendent of steam-shovel operations, was confronted with the problem of getting maximum service from the dippers, one of the greatest difficulties being to avoid lost time in mak-

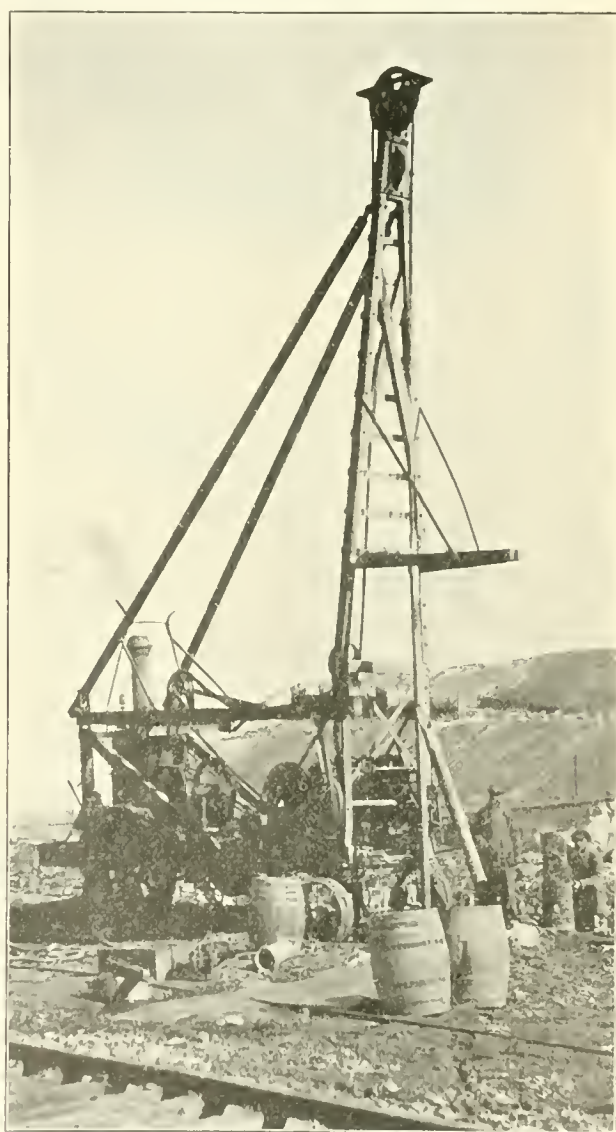


STEAM-SHOVEL DIPPER EQUIPPED WITH VANDERHOFF FRONT AND POINTS

ing repairs when teeth became worn or when teeth-bases loosened or broke. He conceived the idea of a manganese-steel casting in which the bases for the teeth were cast integrally with the front itself. He also designed a reversible tooth so shaped that 65% of the material could be worn away before the casting was scrapped. One $3\frac{1}{2}$ -ton dipper equipped with the Vanderhoff devices operated continuously for 720 days and moved 1,000,000 cu. yd. of material before being discarded. The advantages are great strength, economy in loading, and the small amount of time required for making repairs. A photograph of a dipper is shown herewith.

A bench, 20 ft. wide after the blast, provides adequate room for the loading-track at the proper distance from the path of the shovel when equipped with booms and dipper-sticks of the dimensions stated above. The shovel loads the material from the side between the bank and its own course, as well as immediately ahead, so that the advantage of the long boom in permitting a wide cut is apparent. The height of the bank, 50 ft., has several advantages: 50 to 55 ft. is an economical depth for churn-drilling; it is not so high that the broken rock is likely, when blasted, to bury the loading-track on the shovel-bench, nor so low that an unreasonably small quantity of

ore is broken. A disadvantage of excessively high banks is the consequent decrease in the number of benches on which shovels can work. This under some circumstances might limit the possible rate of production. Very high benches are also a source of danger. At Ruth, the slope between benches is more nearly vertical than in many similar operations, for the reason that the breaking is done exclusively by blasting in churn-drill holes. In consequence, the entire block of ground is shattered, the shovel can work closer to the slope without finding the floor unbroken; and without the same risk from slides and caves that would result from higher banks. The angle of slope for the entire pit, as originally determined upon for calculating the volume of capping that would have to be removed, was 40° from the horizontal. However, it was



KEYSTONE CHURN-DRILL IN OPERATION

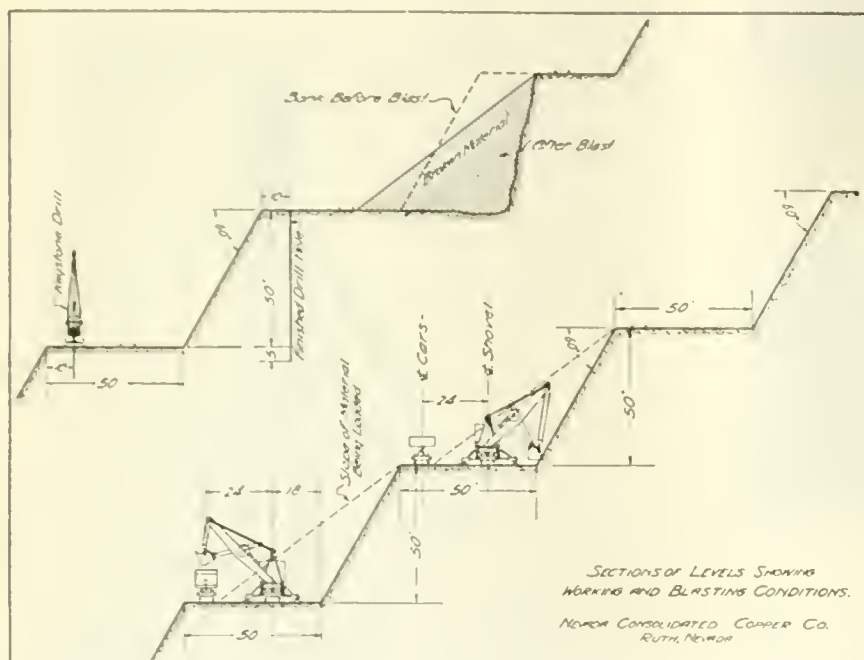
found impracticable, because of the peculiar character of the rock, to carry so steep a slope, and 35° was found to be the maximum workable angle.

It is expected, however, that a final slope when a particular area is completed will be between 40° and 45° ; this will be attained by mining the successive benches to

the angle of repose. It is obvious that unnecessarily wide benches are expensive. The accompanying sketch shows the ideal working conditions. The lines indicating the surface of the broken rock might preferably be more irregular to represent the true condition.

DISPOSAL OF WASTE. More than 30,000,000 cubic yards of capping has been hauled already to the four principal dumps in the vicinity of the pits. The cars used for this work must be staunch enough to stand up under severe service, they must be fool proof, and they must be easy to dump. The large size of the material hauled adds to the difficulty of making a car that will dump easily and quickly. The accompanying drawing gives the principal features of a 20-yd. all-steel dump-car that has met the requirements better than any other at the Nevada Con-

solidated property. Thirty of these cars were built in the company's shops at Ruth. Twenty 18-yd. steel cars and thirty 12-yd. wood cars had previously been supplied by the W. J. Oliver Manufacturing Co. of Knoxville, Tennessee. The capacity of the steel cars was increased to 20 yards and that of the wooden cars to 18 yards by the company by raising the height of the sides and by strengthening various parts. The 20-yd. steel car weighs 20 tons; it has a wheel-base of 14 ft. 4 in. and an over-all length from coupler to coupler of 26 ft. 6 in. The maximum height above the rail is 9 ft. 2½ in. and the inside dimensions of the body are 21 ft. by 8 ft. 3½ in. by 3 ft. 2 in. These cars are mounted on standard-gauge railroad-trucks and are equipped with air-brakes. However, they are dumped by hand rather than by air. I am informed that dumping by air proved unsatisfactory because of continual trouble with the operating mechanism, especially in cold weather; for the winter climate at Ruth is rather severe. The dump-crew cares for the track and does the necessary shifting of the rails to the outer edge as the dump grows.



SECTIONS OF LEVELS SHOWING
WORKING AND BLASTING CONDITIONS.
NEVADA CONSOLIDATED COPPER CO.
RUTH, NEVADA

solidated property. Thirty of these cars were built in the company's shops at Ruth. Twenty 18-yd. steel cars and thirty 12-yd. wood cars had previously been supplied by the W. J. Oliver Manufacturing Co. of Knoxville, Tennessee. The capacity of the steel cars was increased to 20 yards and that of the wooden cars to 18 yards by the company by raising the height of the sides and by strengthening various parts. The 20-yd. steel car weighs 20 tons; it has a wheel-base of 14 ft. 4 in. and an over-all length from coupler to coupler of 26 ft. 6 in. The maximum height above the rail is 9 ft. 2½ in. and the inside dimensions of the body are 21 ft. by 8 ft. 3½ in. by 3 ft. 2 in. These cars are mounted on standard-gauge railroad-trucks and are equipped with air-brakes. However, they are dumped by hand rather than by air. I am informed that dumping by air proved unsatisfactory because of continual trouble with the operating mechanism, especially in cold weather; for the winter climate at Ruth is rather severe. The dump-crew cares for the track and does the necessary shifting of the rails to the outer edge as the dump grows.

I saw a train of six cars emptied; of these four dumped themselves as soon as the locking arrangement was re-

leased; one man tipped the others by a slight push with a small stick of timber. All righted themselves automatically. The operation of the gate, whereby it clears the car by about three feet, is designed to permit large rocks to discharge without interference, and the steep angle of the bottom when in dumping position, about 45°, facilitates the exit of sticky material. Obviously, the car dumps from only one side, but this is no serious objection. The extension to the bottom on the dump side should be noted. It is apparent that these cars work under severe conditions; they are loaded directly from the steam-shovels with large rough rock; then, after a short journey, they are dumped bodily and returned to the shovel for re-loading. It speaks well for the cars that they last so long.

The irregular topography of the neighboring terrain is well suited for affording convenient dumping-space at various horizons, although the largest dump, the Keystone, is 2 miles distant, thereby involving a considerable haul, particularly when dumping is being done on the most distant side, for the dump itself has an area of several hundred acres. The tracks make a complete loop around the outer edge.

The Keystone dump has an available capacity at the present time of 17,000,000 cu. yd., on ground owned by the company. The area beyond is unpatented land, valueless for mining purposes, and accordingly it will be possible to enlarge the dump to any extent necessary. The Stillwater, Puritan, and Sunshine dumps will provide for 12,000,000 additional cubic yards. The Rieptown and Star Pointer dumps have not been used in

recent years.

The Defender dump, which is indicated on the map, was used in the early days to receive capping from the upper benches. The dump is situated over an area composed of extrusive rhyolite and limestone, which originally was not thought to overlie ore. Development work in recent years, however, has disclosed the fact that profitable porphyry extends under the limestone and rhyolite covering. The ore according to Mr. Lakenan is evidently a laccolith from the porphyry core, a significant inference being that the flows post-dated the mineralization of the porphyry. In this connection it may be mentioned that whereas the ore first mined from the Eureka pit was characterized by a predominance of chalcocite, recent development has disclosed ore in which 70% of the copper is in the form of chalcopyrite, and only 30% in the form of chalcocite. This is significant in that it gives promise of primary chalcopyrite ore extending to greater depth than might be expected with ore of secondary enrichment. Drilling in the west side of the pit has substantiated this belief.

The extension of the profitable ore has made it necessary to move a portion of the Defender dump, this work



EIGHT HOLES LOADED WITH 38,200 LB. OF BLACK POWDER AND 400 LB. OF NITRO-STARCH POWDER WERE FIRED SIMULTANEOUSLY. 200,000 TONS OF ROCK WAS BROKEN

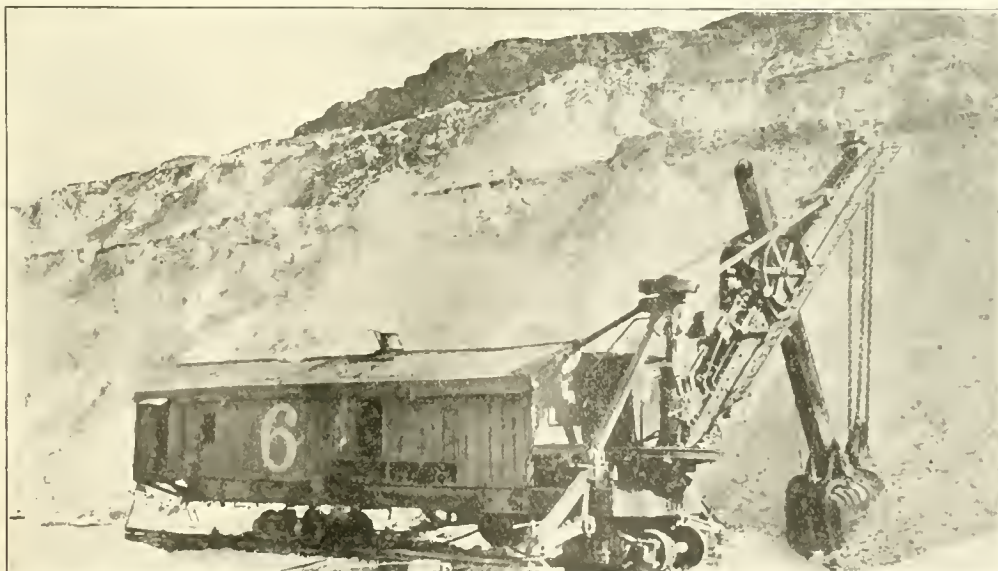
being now under way. Most of the deep-seated ore, both under the dump and in other outlying portions of the deposit, will be mined by underground methods similar to those used in the Ruth mine.

At least one dump has been converted into a valuable economic asset to the company; I refer to the Star Pointer, on the broad surface of which has been laid out an excellent baseball diamond. Here the championship of White Pine county is decided each year, and I am told that fast baseball is played. The fact that no special surfacing material was used, but that the cap-rock from the mine was simply consolidated by a steam-roller, indi-

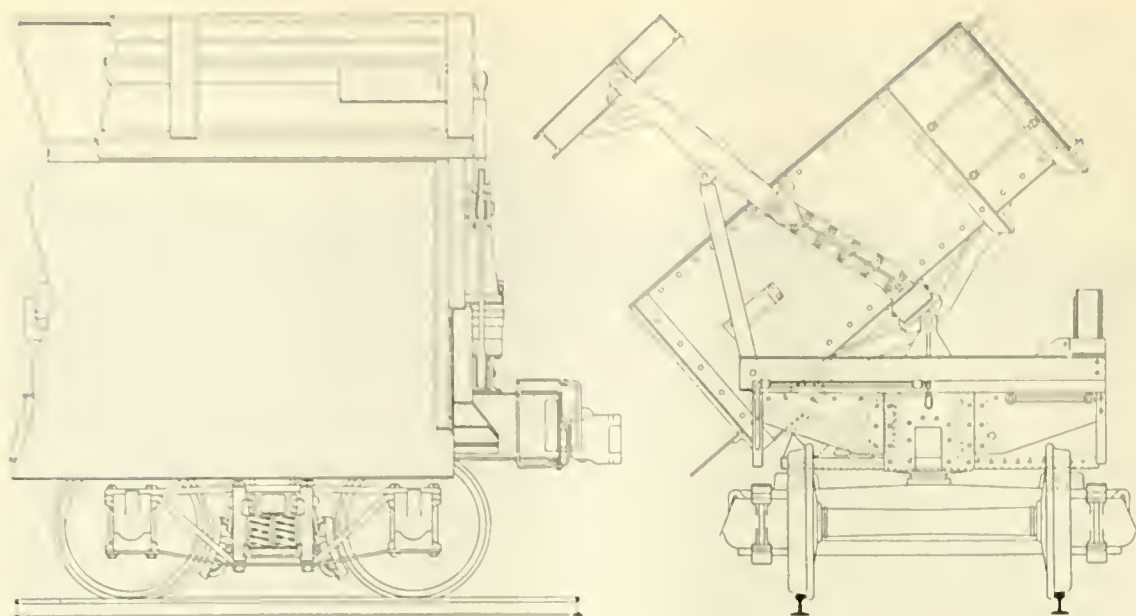
cates the rapidity with which the porphyry decomposes.

'Railroading' plays an important part in the pit operations. The mining company has 19.53 miles of standard-gauge track in the shovel-pit area, and 8.95 miles additional is comprised in approaches to the pit, side-tracks in the assembly-yard, and miscellaneous tracks at Ruth. The maximum grade of the tracks is 4%, this being found near the mouth of the pit, where the tracks from the different benches switch toward the assembly-yard. At least 85% of the track is on a grade of less than 2%.

TRANSPORTATION OF THE ORE. The ore is loaded by the



BU CYRUS STEAM-SHOVEL



STEEL SIDE-DUMP CARS: 20-CU. YD. CAPACITY

shovels directly into 50-ton gable-bottomed steel cars. Tracks for these cars and the 20-yd. waste-cars are required on each bench in the pit. As has been mentioned, these tracks form individual loops that converge outside the pit. In addition there are the tracks leading to the various dumps. The loaded ore-cars are delivered to the assembly-yard, where the trains are made up for transportation to the concentrator. During 1916, 1917, and 1918 the efficient dispatching of traffic was an important factor in maintaining production, and the convenience of the track arrangement in the pit proved decidedly helpful.

On September 1, 1920, a trackage-rental agreement was entered into between the mining company and the Nevada Northern Railway Co., whereby the former took over the operation of the ore-trains to McGill. This transaction included the purchase from the railroad company of eight locomotives, each with a weight of 170,000 lb. on the drivers, and 250 sixty-ton ore-cars of the Ingoldsby type. This change is expected to permit better co-ordination in haulage, with still more economical production.

The Nevada Consolidated company operates 16 locomotives, at Ruth, as follows:

Five	Class 337	Baldwin	65 tons
Seven	Class 336	American	48 "
Two	Class 500	Baldwin	82 "
One	Class 301	American	40 "
One	Class 600	Schenectady	75 "

All are of the 'saddle-tank' type without tenders, except the last one, which is an ordinary switch-engine. Coal is used exclusively as fuel. Each locomotive has a turbo-generator, similar to those on the shovels, except that they are of 335-watt capacity instead of one kilowatt.

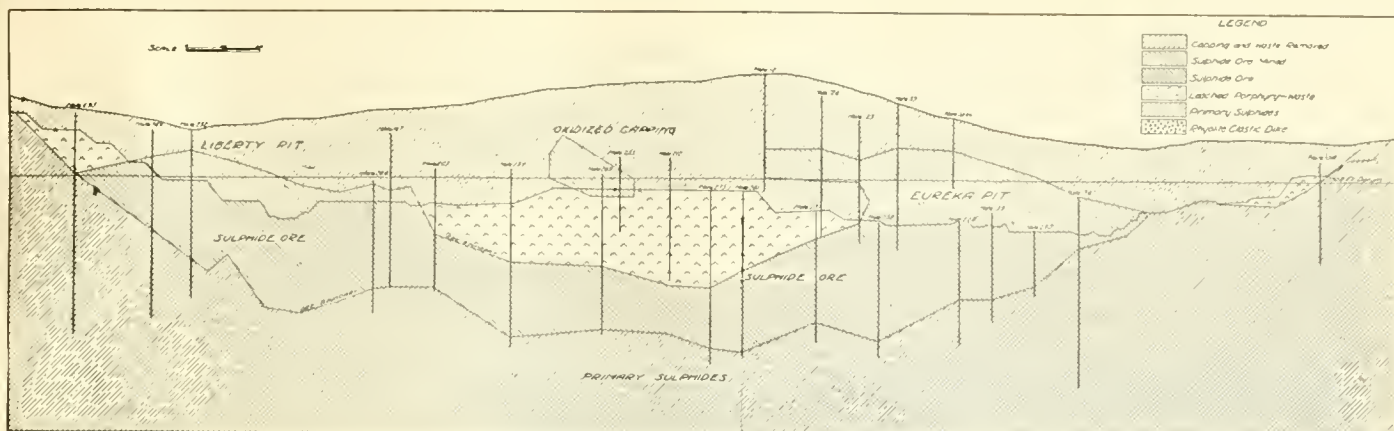
Among other items of heavy equipment are a steam-crane, a 'wash-out', or repair, car, and a Jordan spreader. The crane is of 30-ton capacity with a 44-ft. boom, made by the Bay City works. It is used for unloading coal

into stock-piles and for transferring it, and for cleaning track when covered by heavy blasting. For this work a clam-shell bucket of two-yard capacity is used. Another purpose that the crane serves to good advantage is the loading of churn-drills on a standard flat car for transfer from one bench to another. A suitable sling is prepared and the churn-drill is lifted bodily and placed on the car: the same method is used in unloading at the point where the new hole is to be drilled.

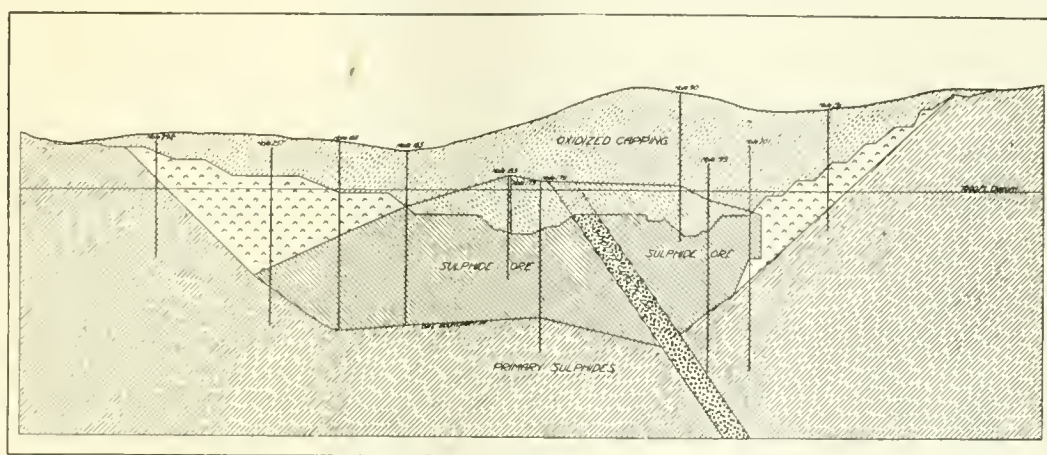
The crane is also used for moving track in the pit. After each cut the track, upon which the trains of ore-cars run, must be shifted closer to the new bank. This is done by means of the crane operating from the bench next above. A sling, made with hooks on each end of a 40-ft. cable, engages a portion of the track. Fastened to the loop of the sling is a pulling-line operated directly from the drum of the crane. Successive lengths of track are dragged laterally a few feet at a time, the crane moving under its own power to maintain the proper direction of pull. In this manner the track is gradually worked to its new position. As much as 1500 ft. has been shifted in six hours with a force of four laborers and the crew operating the crane.

The 'wash-out' car is an old box-car fitted with an acetylene-welding outfit, a power drill-press, a 15-hp. steam-boiler, a small steam-pump, a supply of hose and pipe, sundry jacks and chain-blocks, and a large assortment of hand-tools. The original purpose of the car was to enable the convenient washing of the boilers of the shovels as they stood in position. The plan was elaborated, and now all sorts of minor repairs to the shovels, churn-drills, and even cars, are done expeditiously, a large proportion on equipment that previously was hauled to the shop. Repeated trips back and forth are thereby avoided.

The following data on the efficiency of operations during the first half of 1920 are based on an average output of approximately 6000 tons per day, and are fairly repre-



EAST-WEST SECTION OF THE OREBODY



NORTH-SOUTH SECTION

sentative of what can be done. It should be noted that the unit used with respect to mining is the 'ton of ore'; with stripping it is the 'cubic yard of waste'.

Mining	
Tons of ore mined	1,028,592.0
Shovel shifts	428.6
Tons of ore per shovel-hour	300.0
Tons of coal used on shovels	814.0
Tons of shovel-coal per ton of ore	0.00087
Pounds of powder per 1000 tons of ore	259.41
Locomotive shifts	920.7
Tons of ore per locomotive-hour	139.6
Tons of coal used on locomotives	3,126.12
Tons of locomotive coal per ton of ore	0.00304

Stripping	
Yards of waste moved	1,191,246.0
Shovel shifts	978.29
Yards of waste per shovel-hour	152.2
Tons of coal used on shovels	2,193.1
Tons of shovel-coal per yard of waste	0.00184
Pounds of powder per 1000 yd. of waste	428.58
Locomotive shifts	2,174.88
Yards of waste per locomotive-hour	68.47
Tons of coal used on locomotives	7,495.06
Tons locomotive coal per yard of waste	0.00629

Mention has been made of irregularity in the copper content of the deposit. There are three kinds of porphyry, namely, the ore, the primary porphyry, only part of which can be mined, and the leached porphyry. In addition a clastic dike cuts through the middle of the Liberty pit, and patches of limestone and rhyolite are distributed irregularly through the porphyry ore. These are included in the ground that is mined. It is sometimes impossible to distinguish ore from worthless rock, and accordingly the grade must be determined by current

assaying. On the day-shift three sampler-assayers, and on the night-shift one, follow the work of the shovels. They have a laboratory adjacent to the pit where they 'run' their own samples promptly to determine what material shall go as ore and what as waste. This work is under the immediate supervision of Mr. Foote. His department also is responsible for the sampling of the exploratory and development churn-drill holes; and the surveying and mapping of the pit.

It is interesting to note the results of active development during 1916. The annual report for that year said: "The new ore-tonnage developments occurred principally in the Copper Flat group and were brought about by deeper drilling in the shovel-pit area below the zone of distinct secondary enrichment into ore of good economic grade. Special geological investigations have resulted in classifying the mineralization in these deeper zones as of primary origin. The attached table gives a summary of ore-reserves at the close of the fiscal year. The tonnages as stated are based on a complete revision of sections calculated and estimates:

	Tons ore	Cu %
Total developed ore to December 31, 1915	60,933.454	1.50
Added during year 1916	13,006.597	1.37
Total developed to December 31, 1916	73,940.051	1.48
Ore milled to December 31, 1916	21,096.032	1.65
Recoverable ore remaining December 31, 1916	52,844.019	1.41

"The balance of tonnage shown as remaining at the end of the year will not check with the figures given in

the annual report for 1915 because of some arbitrary deductions both as to grade and tonnage which it was considered advisable to make in connection with the 1915 estimates. The figures now stated do not consider such deductions, being based as they are upon more thorough development and accurate knowledge as to the extent, character, and value of orebodies. In estimating tonnage, all ore has been included up to the vertical boundaries of the orebodies as shown on sections, because the ore in the slopes heretofore mentioned as unavailable for steam-shovel mining on account of excessive overburden, can be successfully and profitably mined by underground shrinkage methods and delivered direct to standard ore cars placed on the steam-shovel tracks at the toe of the slopes."

Subsequently the idea of using underground methods for mining the outer rim of the orebody on the lower horizons was modified and 1,781,896 of 1.429% ore previously designated to be mined by underground methods was re-classified as steam-shovel ore. At the same time an increase in the calculated yardage of capping to be moved was made necessary in order to provide for the winning of this ore with an over-all slope-angle in the pit of 35°. This had the effect of creating the following ratio of remaining tonnage to yardage as of January 1, 1917:

$$\frac{\text{Steam-shovel ore, tons}}{\text{Capping, cubic yards}} = \frac{51,474,653}{39,704,385} = 1.296$$

As against this ratio at the beginning of 1916:

$$\frac{56,123,460}{27,752,502} = 2.05$$

However, at the beginning of 1920 the ratio had improved to:

$$\frac{50,053,540}{38,029,520} = 1.316$$

as compared with the following ratio for the total developed ore since the commencement of operations:

$$\frac{78,358,713}{66,984,473} = 1.17$$

The estimated tonnage to be recovered by underground mining methods as the orebody nears exhaustion, was 4,341,744 at the beginning of 1920 but this will doubtless be increased.

A small plant in the bottom of Eureka pit catches the eye of the observer. It consists of nine boxes, 1½ by 3 ft. in section and with a total length of 736 ft., in which the

copper in the water that accumulates in the two pits is precipitated on scrap-iron. Prior to 1918 this water was pumped from the pit and wasted. The operation was expensive, because the pipes and pumps were eaten away by the copper solution and had to be replaced at frequent intervals. As a result of one summer's operation 17,280 lb. of precipitate, assaying 71.96% copper, was recovered at less cost than that required for the previous pumping. I mention this to show that small details are not overlooked by Mr. Grant and his assistants.

The following general data on the orebody are interesting:

Original area of steam-shovel orebody	84,907	acres
Present area of steam-shovel orebody	83,340	acres
Original average thickness of steam-shovel orebody	263.0	ft.
Ore per acre originally	910,186	tons
Ore per acre remaining	593,817	tons
Total stripping-area	220,001	acres
Area completely stripped	57,220	acres
Area partly stripped	110,705	acres
Area of no stripping	52,139	acres
Average thickness of cap over entire stripping area originally	189.0	ft.
Average thickness of cap over entire stripping area remaining	167.0	ft.
Capping per acre originally	304,386	cu. yd.
Capping per acre remaining	171,830	cu. yd.
Capping per acre of ore originally	788,916	cu. yd.
Capping per acre of ore remaining	453,796	cu. yd.

Costs. The table given below shows the operating cost for the six-year period from 1913 to 1919 inclusive. The cost data for years prior to 1913 are of little value, because conditions then were such as no copper mining company in the United States ever expects to enjoy again. It should be noted that the cost of mining does not include the arbitrary charge added to cover the item of prepaid stripping, but does include every other cost except depreciation and depletion. Prior to July 1, 1918, the stripping suspense-charge was 30c. per ton, but the necessity for maintaining the flatter slope, together with the increased per ton cost of removing the overburden, made it advisable to add 10c. to this charge. The remarkable increase in the cost of producing ore during 1916, 1917, 1918, and 1919 reflects the comparative inefficiency of labor during this period; and in a still greater degree the increase in taxes. The item of taxes is not included in the figures for 1919. During 1915, Federal, property, and bullion taxes totaled only 0.2c. per pound of copper or 4c. per ton of ore, as compared with 15.81c. per ton in 1918.

Nevada Consolidated Copper Co.—Cost of Stripping and Removing Overburden

	1913	1914	1915	1916	1917	1918	1919
Cubic yards of material moved	3,100,661	3,044,967	2,758,356	3,974,952	3,011,728	2,617,771	1,674,865
Cost per yard:							
Drilling and blasting	0.0855	0.0918	0.0738	0.0823	0.0907	0.1026	0.0903
Steam-shovel operation	0.0633	0.0530	0.0434	0.0426	0.0552	0.0647	0.0517
Locomotive tramping	0.1190	0.1087	0.1070	0.1229	0.1479	0.1862	0.1777
General pit expense	0.0072	0.0055	0.0086	0.0071	0.0077	0.0095	0.0100
Miscellaneous	0.0078	0.0581	0.0577	0.0460	0.0428	0.0490	0.0568
	0.3428	0.3171	0.2885	0.3009	0.3443	0.4120	0.3865
Cost of Producing Ore							
	1913	1914	1915	1916	1917	1918	1919
Tons of ore mined	2,889,389	2,513,241	2,991,782	3,337,570	3,076,285	2,711,743	1,390,903
Cost per ton:							
Breaking ore	0.0468	0.0416	0.0374	0.0421	0.0485	0.0527	0.0586
Steam-shovel operation	0.0407	0.0304	0.0208	0.0248	0.0320	0.0395	0.0257
Locomotive tramping	0.0374	0.0301	0.0251	0.0297	0.0458	0.0667	0.0605
General pit expense							0.0245
Miscellaneous	0.0522	0.0497	0.0694	0.1404	0.2075	0.2580	0.1544
	0.1771	0.1518	0.1524	0.2370	0.3338	0.4169	0.3237

Electric-Furnace Practice at Treadwell

By W. E. Cahill

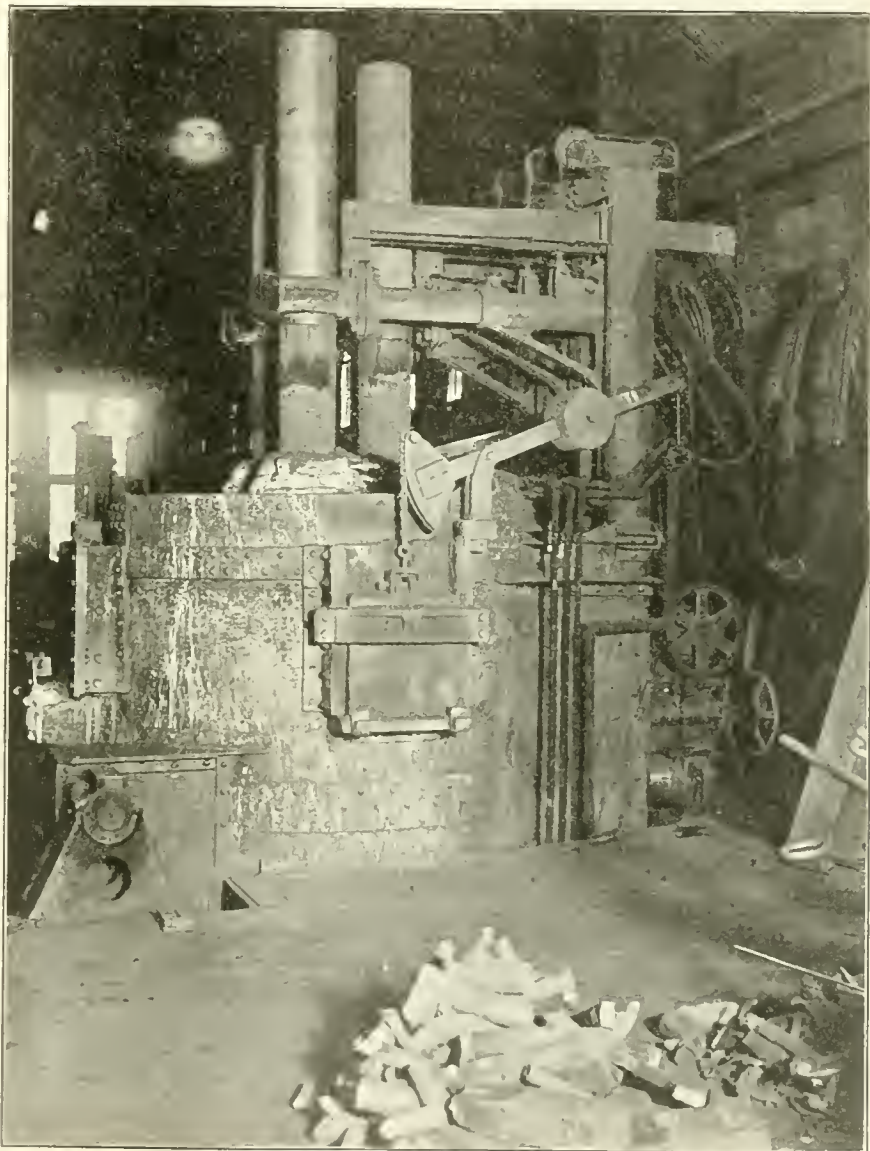
In 1917 a two-ton Heroult electric furnace was ordered for the Alaska Treadwell Gold Mining Co. It was constructed by the American Bridge Co., and, when completed, was requisitioned by the War Department and shipped to the United States Arsenal at Watertown, Massachusetts. The order was repeated by the Treadwell company and the furnace was delivered in June 1918. It was ready for operation in October of the same year.

The original lining of the furnace consisted of a layer of 9-in. 'metalkase' magnesite brick set on end in the bottom. On top of the metalkase brick was placed a layer of standard 9-in. magnesite brick, set on edge. The walls were built of 13½-in. metalkase keys and straights. The arches were built of standard 9-in. magnesite brick. The hearth was made by ramming in dead-burned magnesite grains which had been mixed with hot tar. This was burnt by putting coke in the bottom and turning on the current.

This lining was sent with the furnace and laid according to instructions. It proved to be satisfactory, even under inexperienced treatment, but expensive, and its use was discontinued after the first installation. However, I have always thought well of the manufacturer for sending the metalkase lining, as it relieved us from some of the worries while learning to operate the furnace properly. Metalkase magnesite bricks do not spall, and we used three roofs before having to replace the walls; but, with the exception of two layers of these above the slag-line, silica brick is now used entirely for the walls and arches.

The roof, made of standard 9-in. silica brick with skewbacks of special shape to form the outside ring, is the greatest source of trouble, owing to the fact that the furnace operates from four to seven hours only each day. The expansion and contraction causes considerable spalling of the silica brick. The first roof we made lasted 64 heats; by changes in construction and greater skill in operation we have increased this duty to 185 heats, which I think, considering the conditions, compares favorably with practice elsewhere.

The electrodes used are of amorphous carbon and 12 in. long. The average life per set is about 20 heats. Great care must be used in making joints; the threads on the electrodes and nipples are molded and show varia-



ELECTRIC FURNACE READY TO START

tion in size. By carefully selecting the nipple beforehand, a good joint can be made and no time is lost, a paste of ground graphite and water being used for filling the spaces. Poor joints grow worse with every heat, and a great deal of power is wasted in heating the carbon. At times the resistance will become so great that the electrode will break, which often happens when it becomes penciled, when much current is being forced through a diminished area. This is one of our troubles.

as the furnace is idle for so many hours, and during part of the time the electrodes are at a temperature high enough to oxidize the carbon. I doubt if, under the same working conditions, graphite electrodes would pencil so much as do the carbon electrodes. However, the consumption is not excessive, and it would necessitate changes in the electrical equipment in order to make possible the comparison.

The power is obtained from the hydro-electric plants of the Alaska Treadwell Gold Mining Co. The control is handled through the Alaska Juneau power plant, and is augmented during periods of water-shortage by an auxiliary steam-plant. At times we connect with the Alaska Gastineau power-plants. The service is good, and power is available at practically any time; it is delivered to the foundry at 2200 volts, and is stepped down through an 850-kva. General Electric transformer to 100 volts. Alternating current is used with a 60-cycle frequency. The electrode control-motors are operated with 250-volt direct current, furnished by a small motor-generator at the furnace. The tilting-motor is operated by 440-volt alternating current.

We are one of the pioneers in the manufacture of iron castings by means of the electric furnace; in fact, it is only practised in the East for castings that require a superior quality of metal. With coke at \$50 per ton delivered, and pig-iron at a correspondingly high price, the cost of producing iron in the electric furnace is less than by melting it in the cupola with coke. In cupola melting, the iron, as it melts in passing through the bed of hot coke, picks up sulphur. The action of the blast oxidizes some of the silicon, and introduces gases into the metal. These reactions tend to make the iron hard. This is offset by the addition of pig-iron to dilute the sulphur and to replenish the silicon by the excess it contains. In the electric furnace the action is different. In the first place the iron is melted under a neutral or reducing atmosphere. The metal is refined under a calcium-carbide slag, which removes the sulphur even to the limits of that found in steel, whereas the silicon is not appreciably reduced. No pig-iron is required, as the metal is softer and stronger than that of the original charge. The chemical composition of the iron is under control; if it be found desirable to raise the silicon or manganese content, this can be done by introducing the ferro-alloy directly into the bath of molten metal. The temperature of the iron is under the direct control of the operator. Dull iron is a thing forgotten. There is no rush to keep the iron away from the cupola. The whole charge can be taken at one tap, or any desired amount at intervals. Little hearth repairing is necessary after an iron heat, from twenty to fifty pounds of magnesite being sufficient for the purpose. In making white-iron castings the high temperature attainable makes it possible to pour very thin sections. At times it is necessary to convert part of the remaining charge of gray iron into white iron; this can readily be done by the addition of ore. The shrinkage of electric-furnace iron is less than that of cupola iron; aside from the merit of purity, its superiority is due in a large measure to the absence of occluded gases.

'Insulation' is common when starting the furnace on heavy scrap-iron. It often happens that the three electrodes will rest on top of the charge, and no current passes through. A good remedy is to add a few shovel-fuls of clean turnings. In extreme cases one can always shovel in some coke, bringing the current over the top of the charge until a steady arc results.

Iron castings are made about three or four times per week, the usual practice being to pour in the morning. Every afternoon we take off a heat of steel—high carbon, low carbon, or alloy, depending upon the requirements. The melting of cold steel scrap in a cold furnace gave us considerable trouble at first. The melting starts at the top of the pile directly under the electrodes. The electrodes gradually work their way toward the bottom. As the steel melts it drops down and strikes the cold magnesite hearth, and freezes. The electrodes continue their downward path until a pool of molten steel is formed and the melting of the scrap raises the level of the bath. The course is then upward until all the scrap is added. The layer of solid steel on the bottom cannot be melted by keeping the heat on the bath and without overheating or injuring the furnace. The trouble seems to be due to lack of circulation, the hot metal being on the top. This circulation can be ensured by the addition of iron ore, which causes the metal to boil, and so washes out the layer of frozen metal. Hematite has proved most satisfactory for this purpose, as its action is quick and the effect on the slag is slight. Frequent testing of the bottom with a steel bar is necessary; for, after the steel is free, continued boiling will wash out magnesite, causing slag troubles. This condition is common when using heavy scrap. When proper scrap is available, the density of the charge may be so arranged that the electrodes will penetrate near to and will heat the bottom. Great care must be used when the scrap is light, especially if the electrodes are penciled, for the pool of steel formed might not be of sufficient depth to prevent the electrodes from boring into the bottom. It is advisable to know the length of the electrode (that is, the distance from the holder to the furnace bottom), so that if the position becomes dangerous, the current may be reduced until it starts to rise.

Several months ago we had a 'heat' of steel nearly ready to pour, but the power went off and the charge froze in the furnace. A break in the line kept the current off until the next day. By chipping away the slag from under the electrodes we were able to start the circuit. After having the current on the solid chunk for two and a half hours the maximum depth of the pool of molten steel was about three inches. The furnace was getting very hot, so we started feeding ore. When the carbon content became low, pig-iron was added. By alternate additions of ore and pig, the steel was finished, and the furnace was poured clean within five hours from the start.

The charging of the furnace influences the melting. Gates and risers make a good charge for the bottom, giving the proper density; and, being at the bottom, the coating of sand does not interfere with the electric con-

ductivity when starting operations. Light scrap is placed on the top and may be piled a foot or more above the doors. A small piece of coke is placed on top of the scrap directly under each electrode. The coke makes a better contact, acts as a cushion, and prevents violent surges of current when starting. The former practice of using hand-control for starting has been discontinued, and automatic control is now used. Peak loads seldom exceed 850 kw., whereas the working load is between 500 and 600 kw. After a steady arc is formed, usually about five minutes after starting, lime is shoveled around the electrodes to form the basic slag. Later, as the charge melts, more lime is added. If the scrap melts so as to expose part of the roof to the glare and reflected heat of the arc, it is well to work over some of the light top scrap with a bar, so as to shade the arc and prevent unequal heating of the roof.

By far the most distinctive feature of the electric furnaces is in connection with slag-control and manipulation. The high temperature permits the formation of a limey oxidizing slag for dephosphorization, which, however, is not, strictly speaking, a high-temperature reaction, as better results seem to obtain by reducing the current while removing phosphorus. If it is not necessary to lower the phosphorus content, the slag of the melting-down period can be reduced and changed to a carbide slag by the addition at intervals of small amounts of ground coke. The action of the carbide slag is to remove the sulphur as calcium sulphide and to de-oxidize the bath. As basic slags are refractory and poor conductors of heat, they should be kept at such a consistence as almost to completely veil the arc. The refining period is the most severe one in furnace operation, and if proper attention is not paid to the slag, serious damage may ensue. Owing to the reflected heat, it is impracticable to refine with a high voltage. We are adopting voltage-control, using the high voltage for melting the stock and the low voltage for refining.

The electric furnace is the only type in which the metal is 'finished' in the furnace; nearly complete de-oxidation is practicable; the ferro-alloys may be added there, with negligible loss, and with more complete dissemination. Manganese-steel may be used to replace ferro-manganese, if added to the bath during de-oxidation; the alloys of most alloy-steels may be conserved by melting under a reducing slag and by de-oxidizing. We made one heat of ferro-chrome, but as the furnace is not adapted to its

manufacture, and the action on the lining is severe, no further attempt was made. At the present time the company is adding a heat-treating furnace, and it is expected that manganese-steel will be produced in the near future.

The exports of non-metallic minerals and of electrochemical products, as well as of copper and nickel, have grown to such an extent, due to the use of Canadian



POURING STEEL AT TREADWELL

water-power, as to give Canada a recognized status as a leader in mining and metallurgy, states the Canadian correspondent of the 'Commercial and Financial Chronicle'. The growth of the rubber-tire industry in the Dominion is really an outcome of the distribution of cheap power. The Provinces of Ontario and Quebec, representing the industrial hub of the Dominion, have been blessed with enormous water-power resources; and not only by private enterprise, but by direct participation of the Provincial governments in power development and transmission, have these resources been utilized.

Italy's Mineral Production in 1920

Provisional figures have been obtained from the Italian Ministry of Agriculture with regard to the production of the principal minerals during the past year, and are given in a recent consular report. For 1919 only the production within the old boundaries of Italy is included, whereas in 1920 the production of the new Provinces of Trentino and Venezia Giulia, acquired as a result of the War, has been added. From the figures given below it will be noted that zinc and bauxite are the only minerals that were produced in important quantities in the new territory during 1920:

Minerals	Trentino Tons	Venezia Giulia Tons
Lead	100	1,800
Zinc	5,980	18,930
Iron pyrite	1,550	.....
Fossil fuels		
Coal	375	106,490
Lignite	3,100	.....
Shale (ichthyolic)	525	.....
Bauxite	.....	6,000

The production of iron ore showed a considerable decrease in 1920 as compared with the previous year, because the majority of the blast-furnaces have been shut-down owing to shortage of coal and high production costs. Stocks of ore have been accumulating. In the case of copper a radical reduction took place which it is difficult to explain; both lead and zinc show an increase, a portion of which is accounted for by the added production of the new Provinces.

Fuels show an increase of more than 50%, due to the more extensive use of lignite. The total, however, is below the maximum attained during the War, the production of lignite alone having exceeded 2,000,000 tons in 1918. While under ordinary circumstances lignite can hardly be considered a satisfactory fuel, Italy has found it possible to utilize it on a considerable scale. The following table gives the estimated mineral production in Italy during 1920 as compared with production in 1919:

Minerals	1919 Tons	1920 Tons
Iron ore and ferro-manganese	465,655	423,300
Manganese ore	30,841	29,140
Copper ore	16,653	6,360
Lead ore	32,130	36,325
Zinc ore	65,629	98,090
Silver	8,240	500
Antimony	10	125
Iron pyrite (including cupriferous)	372,474	322,450
Mercury	548	1,325
Fuel:		
Lignite	1,158,541	1,662,430
Anthracite		28,600
Coal (Triassico)		120,715
Bituminous shale		22,000
Shale (ichthyolic)	.....	495
Sulphur, raw and ground	255,316	293,000
Petroleum	4,851	4,750
Asphalt and bituminous rock	78,635	108,600
Bauxite	.....	37,960
Graphite	7,626	4,190

The sulphur industry, which has been steadily declin-

ing for some years past, appears to have been more active in 1920, the production during the year having increased about 15% over that of 1919.

Trade With Soviet Russia

The following statement has been issued by Herbert Hoover, Secretary of Commerce:

The question of trade with Russia is far more a political question than an economic one so long as Russia is controlled by the bolsheviks. Under their economic system there can be no real return to production, and, therefore, Russia will have few commodities to export and, consequently, little ability to obtain imports. No export commodities in Russia today are worth considering, except gold, platinum, and jewelry in the hands of the bolshevist government.

No better indication of the decline of production under the bolshevist system exists than in the case of flax. Pre-war Russia produced 500,000 tons of flax per annum and the country consumed 120,000 tons. The production in 1920 was about 40,000 tons—with mills capable of spinning at least 120,000 tons. In any event, no export flax is available, nor ever will be available, under this economic system. Nor can trade with Russia, so long as it is under a government that repudiates private property, be based on credit. Thus the whole question from a trade point of view develops into furnishing commodities equal to the gold, platinum, and jewelry, variously estimated from \$60,000,000 to \$200,000,000, in the hands of the bolshevist government; and after that has been expended there can be little expectation of continued trade. There has been no prohibition on trade for a long time so far as exchange of commodities is concerned. Trade is open through the Baltic States; Italy has been trading in the South. The real blockade has been due to the failure of the Russians to produce anything except gold and platinum to trade with.

There has been but little trade for gold, because its title has been called into question by the French government, and by threats of private actions in the courts, on the ground that it is stolen or subject to foreign liens. It is apparently the intention under the British trade agreement to allow this matter to be threshed out, so far as England is concerned, in the British courts. The terms of the German agreement are unknown. If any one European nation accepts the gold, no doubt all of them will. Europe cannot recover its economic stability until Russia returns to production. Trading for this parcel of gold would not remedy the situation. The abandonment of the present economic system is essential to a restoration of production.

THE Terrazas holdings in Chihuahua, amounting to nearly 4,000,000 acres, have, as a result of a presidential decree, been returned to the Mexican government. The grant was made by Porfirio Diaz, under certain conditions as to development, improvement, and survey; but nothing has been done in this respect, so the land reverts to the State.

Homestake Mine Construction

By R. G. Wayland

*The construction program of the Homestake mine provides for three underground crusher stations and loading pockets below the 800-ft., the 1400-ft., and the 2000-ft. levels, respectively. Fig. 1, which shows the equipment at the 800-ft. level, will make clear the general arrangement and the plan of operation. Ore from levels above the 800-ft. level will be trammed to a line of transfer raises, through which it will be dropped upon the grizzly above the 48-in. by 36-in. jaw crusher; and ore from the 800-ft. level will be dumped directly upon this grizzly. The grizzly will consist of 6-in. steel shafting on cast-iron supports such as are used elsewhere underground. The opening will be 6 in. The undersize will drop into the ore pocket, which has a capacity of about 1600 tons. The oversize slides to a 5-ft. by 5-ft. 3-in. apron feeder, which conveys it to the crusher.

The crusher has a 48-in. by 36-in. opening, and is set to crush to $4\frac{1}{2}$ in. The frame is of semi-steel, cast in halves, which will be held together by keys and heavy-steel bands. The pitman is of new design, so arranged that the force necessary to break the ore is transmitted in tension through two 5-in. steel shafts, instead of a casting as in usual practice.

The crusher will be driven through a short belt drive by a 125-hp., 720-r.p.m., 2200-volt, slip-ring motor. The capacity of each crusher unit will be about 200 tons per hour. The crushed ore will join the undersize from the grizzly and will fall into the 1600-ton ore pocket, from whence it will be drawn into 7-ton skips through measuring pockets.

The alteration of the timbering in the Ellison shaft is shown in Fig. 2. The old arrangement provides two 5 by 10-ft. cage compartments, and one 6 by 10-ft. pipe and ladder-way, making the outside dimensions of the shaft 12 by 20 ft. The change to the new arrangement is effected by moving the dividing timbers between the old cage and pipe compartments 6 in. to the south, thus making each compartment 5 ft. 6 in. in the clear. The new pipe compartment and the compartment for the cage counterweight and ladderway are separated from the two-skip compartments by 6 by 10-in. dividers and 2-in. lagging. The use of the north cage will be continued. All other main timbers are of 12 by 12-in. Washington fir.

At the collar of the shaft the old steel head-frame has been replaced by a new one, which carries four sheaves, as shown on Fig. 3. The centres of the new skip-hoist sheaves are 95½ ft. above the collar of the shaft; the cage sheaves are in the same position as before, except that the counterweight sheave has been moved back.

The skips are dumped into the ore-bin in front of the new head-frame. The ore as dumped falls upon a deflect-

ing platform and flows over a grizzly having 3-in. openings. This grizzly will consist of hard cast-iron bars 6 in. deep, $1\frac{1}{2}$ in. thick on top, and 1 in. at the bottom, set into cast-iron supports carried on I beams.

The undersize will fall on a 36-in. belt-conveyor. The oversize will be fed by two apron feeders to four No. 6

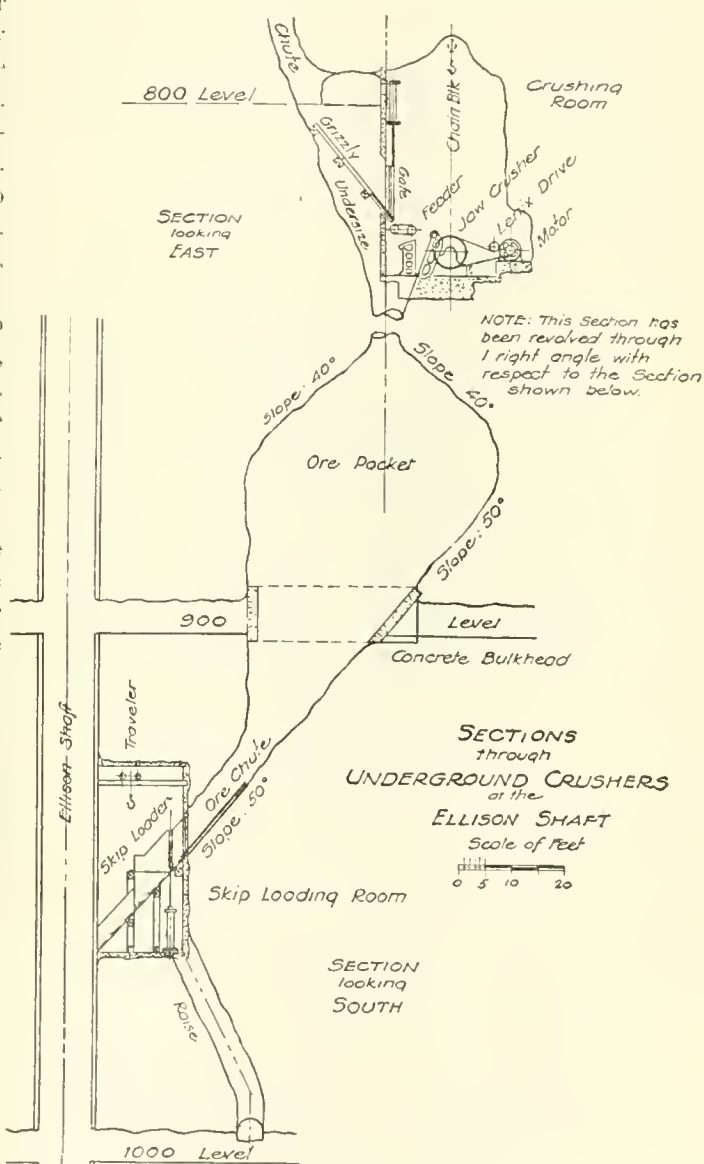


FIG. 1

Gates gyratory crushers, set to 3 in., the product of which will fall upon the conveyor and be carried over a system of magnet pulleys, not shown, to a revolving screen having 3-in. round openings. The undersize will fall upon a 36-in. by 49-ft. shuttle conveyor, where it will be joined by the oversize, after the latter has passed through two No. 6 gyratory crushers set at 2 in. The shuttle conveyor

*Abstracted from the 'Pahasapa Quarterly'.

will distribute the ore to the present ore bin, which is 100 ft. long and about 20 ft. wide, whence the ore will be drawn into the mill tramway cars 60 ft. below.

The winding part of the new Ellison electric hoist is a 36,500 lb. rope-pull, 2000 foot-per-minute rope speed,

double drum hoist, with plate-steel drum 10 ft. in diameter by 7 ft. 2 in. face, structural-steel parallel-motion post brakes, Brown clutches, oil-operated auxiliary engine, and complete safety features.

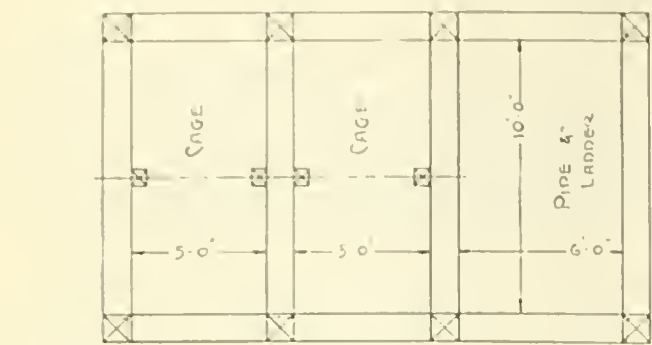
The hoist is direct connected to a 1400-hp., 600-volt direct current motor, having a full-load speed of 63½ r.p.m. The current for this motor is supplied by a fly-wheel motor-generator set, and the control is of Hgner-Ward-Leonard design. The alternating-current motor is rated at 1200 hp., and the power input is held approximately constant at this figure by the fly-wheel, which weighs 72,000 lb. without the shaft. The output of the direct-current generator at the other end of the set varies from plus 2800 hp., during acceleration, to minus 1400 hp., during retardation. The set operates at 600 r.p.m. synchronous speed.

The conditions under which the hoist is to operate are as follows:

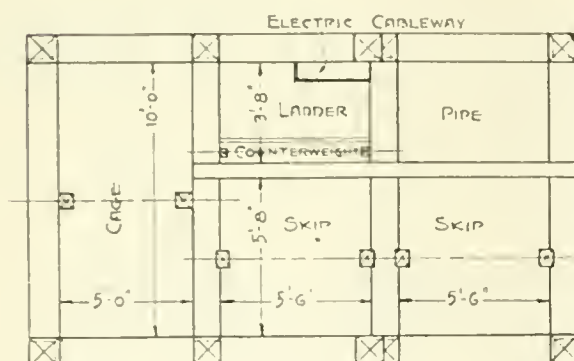
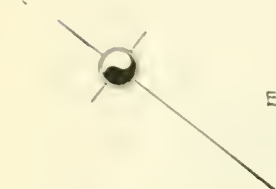
Shaft inclination	vertical
Weight of ore, pounds.....	14,000
Weight of skip, pounds.....	10,750
Size of rope, inches.....	1½
Maximum length of running rope, feet.....	3,230
Weight of rope, pounds.....	11,500
Period of acceleration, seconds.....	15
Period of retardation, seconds.....	10
Rest period, seconds.....	15
Maximum speed, feet per minute.....	2,000

Under these conditions the hoist will have a capacity of 4000 tons in 15 hours from a depth of 2230 ft., which is the depth of the loading pocket of the crusher station at the 2000-ft. level. The ultimate depth of hoist is to be 3230 feet.

MODERN MILLING PRACTICE tends toward the re-arrangement of well-known machines, rather than to any specific improvements in the design of pulverizers. Where fine grinding is practised, three- or even four-stage crushing may be economically employed, each machine being chosen for successive reduction as being specially adapted for the grade of material it is called upon to handle.



PLAN
OF
OLD
TIMBERING
IN
ELLISON SHAFT



PLAN
OF
NEW
TIMBERING

SCALE OF FEET
3 2 1 0

FIG. 2

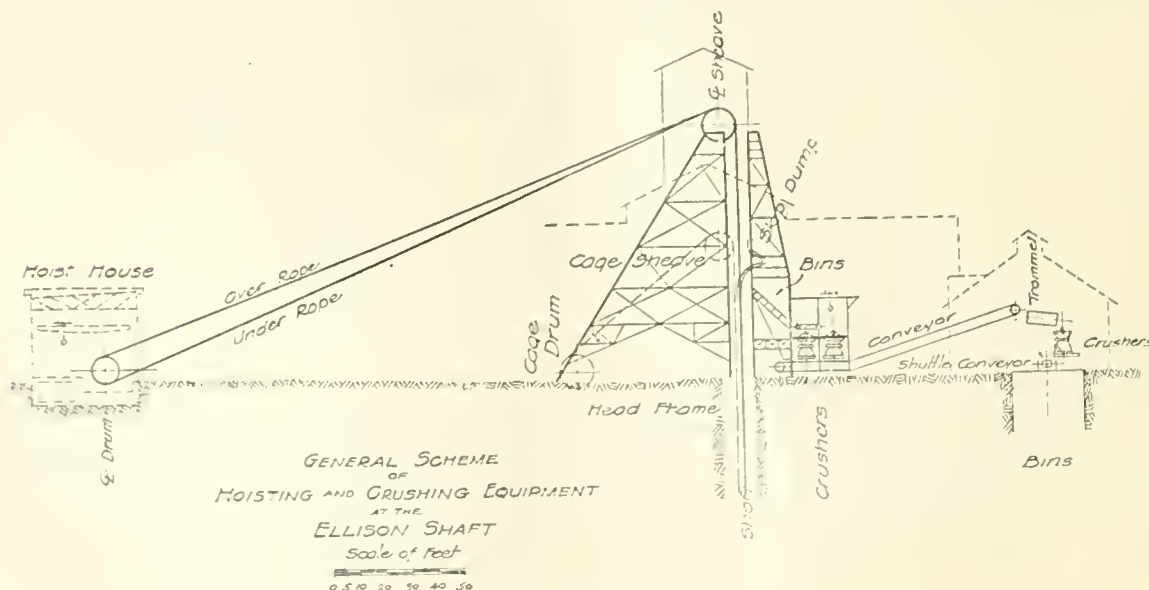


FIG. 3

REVIEW OF MINING



IMPORTS OF GOLD

Gold appears to be flowing into this country from all quarters, especially from Europe. Since the beginning of the year net imports are calculated at about \$150,000,000, and bankers expect a continuation of the movement. Scarcely a day passes without the arrival of some shipment, a recent arrival being \$4,000,000 by the steamship 'Rotterdam' consigned by the Netherlands Bank to the Federal Reserve Board. According to the Federal Reserve Board, \$28,795,000 was imported in the 10 days ended March 20, and \$133,303,000 between January 1 and March 20. Against this there was an outflow of only \$4,349,000 in the longer period and \$338,000 in the shorter. Since March 20, shipments of over \$22,000,000 have been reported en route or arrived. Thus total imports since January 1 are over \$155,000,000.

The bulk of the shipments are from England, but France makes a close second. The board's figures give \$43,588,000 from London between January 1 and March 26 and \$37,066,000 from Paris. Since March 20, reports indicate a further \$9,433,000 from London and a further \$7,000,000 from Paris. Sweden accounts to date for \$8,014,000, the Netherlands for \$5,218,000, and India \$9,662,000. Europe accounts to date for nearly \$112,000,000, North America for \$14,600,000, including \$10,000,000 from Canada, South America for \$5,000,000, and Asia for nearly \$22,000,000. No gold was exported to Europe and the only considerable shipment abroad is \$3,000,000 to Cuba.

OPTION ON FLIN FLON MINE LAPSES

The option under which a syndicate headed by W. B. Thompson, of New York, was to pay \$1,500,000 in cash for the Flin Flon copper mine in northern Manitoba, north of The Pas, lapsed on April 1. The low price of copper and the tightness of the money market are the reasons given for failure of the Thompson syndicate to take over the property on which it has spent more than \$200,000 in development work. Since the discovery of the Flin Flon property in 1915 it is estimated that various concerns have spent a total of \$750,000 on it. The government of Manitoba recently spent between \$15,000 and \$20,000 on surveying a railroad to the property on the understanding that the syndicate would repay that amount should it fail to exercise its option. It has been estimated that expenditures which might run to \$20,000,000 would be involved in the purchase of Flin Flon by the Thompson syndicate, this including the proposed railroad from The Pas, the construction of a new mining town, the development of water power, etc. Based on the average prices of twenty years and not including extreme prices during the war period, the metal contents of Flin Flon ore have an estimated valuation of \$112,000,000.

TRANS-ATLANTIC FREIGHT-RATES ON COPPER ORE DOUBLED

Ocean freight-rates on copper to French Atlantic ports, Hamburg, Rotterdam, and Antwerp have been practically doubled. The new rate to Hamburg is \$8 per long ton, against \$3.50 to \$4 recently, and \$2.50 before the War. Even now the rate is considerably below that to Great

Britain. This is now \$11 per ton, having been reduced from \$13 several weeks ago because of trans-shipment business appearing from French ports owing to the rate of \$3 per ton then prevailing to Havre. Whether the British rate on copper will again be raised to \$13 as a result of the increase to Havre and Hamburg remains to be seen. French and German buying of copper the last two weeks, of at least 20,000,000 lb., is believed due in part to realization of probably early ending of the rate-war between French and British and American conference companies serving French Atlantic, German, Belgian, and Dutch ports and an increase in freight-rates. The rate-increase to Hamburg amounts to about 0.18c. per pound, making present freight cost of shipping copper to that port about 0.36c. per pound. The Copper Export Association is expected to raise its quotations this week enough to compensate for the rate-increase, as at present the Export Association's quotations on copper for English, German, and French deliveries are slightly below those of the independent exporters.

ADMINISTRATION OF COLORADO SCHOOL OF MINES VINDICATED BY LEGISLATIVE INVESTIGATING COMMITTEE

The legislative committee that has been investigating the State School of Mines at Golden has found that "The management and administration of the School of Mines is efficient, the trustees, officers, and faculty are competent, well qualified, and trustworthy, and the institution, members, officers, faculty, and trustees are entitled to the support, respect, and encouragement of the citizens of this State, the alumni of the institution, and the general public."

It seems that the main issue was whether or not the school should be operated under the existing system of appointed trustees or be placed under the management of the Board of Regents of the State University or some new body with the supervision of all State schools. Other than this, the next most important question was whether or not the president, Dr. Victor C. Alderson, was the proper head for the school. His critics contended that, judging from his report on mining and shale properties and his writings as scientist and geologist, he was not the proper person to be at the helm of such an important institution. They alleged that such reports, written by a freshman at a school of mines, would be grounds for expulsion. The committee, after its investigation, unanimously recommended that this and all of the State schools should be controlled by one governing body that would have power to co-ordinate the activities of the various schools, retaining the individuality and identity of each.

ALASKA

Juneau.—J. C. Gotwals arrived here on April 3, after traveling 1450 miles in the interior by dog-sled. He states that three dredges are being shipped into the Ophir district by the Union Construction Co. Two of these will probably be operated this season on Yankee and Gaines creeks, tributaries of Ophir.

Substantial development work on its quartz property at Nixon fork is being done by the Treadwell company. A large amount of cross-cutting and shaft-sinking has been

done, and the company is preparing to put in a 10-stamp mill on the property.

Some placer activities were noted by Gotwals along the route. Two operators at work on Ruby creek, just below Nixon fork, reported good results. Four were at work on Poorman, employing 50 to 60 men, taking out winter dumps.

The Kantishna district, Gotwals said, is being prospected for lode deposits, but it is likely to be very discouraging to small prospectors for the present and until a substantial mine and mill are established there. A prospector going to the Kantishna now would have to depend on medium grade and spotted placer for his livelihood and the development and exploitation of such lode claims as he might discover would be difficult.

J. A. Sutherland, Carl Selberg, and Sylvester Howell of Fairbanks will put a hydraulic plant on Moose creek this summer. The hydraulic plant shipped last summer by the Mount McKinley Placers Co., which is backed by Cleveland, Ohio, capital, did not reach Glacier creek, where it is to be installed, but will probably be set up early this season.

The Alaskan engineering commission is making excellent progress, according to Gotwals, on the Alaska railway construction, and favored by a good winter is pushing work with vigor.

ARIZONA

Bisbee.—Arthur Notman, superintendent of the Copper Queen mines in Bisbee, states that, effective January 1, 1922, there is to be a normal production of 8,000,000 lb. of copper per month, half of which is to come from the deep mines now in operation and half from the low-grade ore from Sacramento hill. The stripping operations at Sacramento hill are in advance of necessary construction; it is estimated that six months will be required to complete the new power-house and nine months to complete the new 4000-ton mill.

Annual reports of the Calumet & Arizona Mining Co. of Bisbee, and the New Cornelia Copper Co. of Ajo, which are controlled by the same officers and general manager, have been published. John C. Greenway, general manager, reports to the Calumet & Arizona directors that the mines were operated at less than 60% of normal throughout the year. With regard to the increased cost of production he gives the following interesting tabulation of increases since 1915:

	Increase, %
Average labor rate at mine and smelter.....	44.9
Average salary rate at mines and smelter.....	37.5
Explosives, per box	\$4.6
Timber, per thousand feet.....	120.6
Fuel oil, per barrel, at mines.....	38.6
Fuel oil, per barrel, at smelter.....	25.0
Coke, per ton	22.5
Freight-rates	69.4
State and county taxes	108.0

The report of H. A. Clark, superintendent of the smelter at Douglas, to John C. Greenway, general manager, states that the smelter was operated at about 47% capacity during the year, and the acid plant at 70%. Value of mining property less reserve for ore depletion is placed at \$22,109,-\$91; of smelting plant less reserve for depletion, at \$1,605,-\$910; metals on hand and in process (estimated at 12½c. per pound), at \$4,699,143. The gross income is given as \$11,418,573 and the net income as \$1,849,201.

The report of the New Cornelia Copper Co. states that a total of 40,104,493 lb. of copper was produced, and \$900,000 paid in dividends.

John C. Greenway, general manager, states that sulphide ore is already being exposed in No. 2 hill. Within two years, at normal production, the mine will be in shape to produce 5000 tons of sulphide ore per day. As soon as financial con-

ditions permit, the producing capacity of the mines should be doubled by the construction of a 5000-ton flotation plant for the treatment of this sulphide ore.

A noteworthy change in the process at Ajo, where the reduction works are situated, has been the success in returning a large proportion of the cement copper to the solution, reducing some of the ferric iron in solution to ferrous iron, and recovering the copper again as electrolytic copper. In 1920 only 7.0% of the copper from the leaching plant was in the form of cement copper, as compared to 17.7% in 1919, and 25.8% in 1918. The consumption of sulphuric acid in leaching has decreased from 2.314 lb. per pound of copper in 1919 to 1.69 lb. in 1920. This decrease was largely due to the fact that the deeper ore contains less dirt and soluble impurities than the surface ore.

In spite of high wages, prices for supplies, exorbitant taxes and freight-rates, the cost of copper from the leaching-plant was nearly a cent per pound less than in 1919. This improvement was very largely due to the larger proportion of electrolytic copper, although the crushing cost, leaching cost, and cost of electrolytic operations decreased considerably. The experimental flotation mill was closed down at the end of February, after a successful six months run.

Globe.—Decision to sell the properties of the porphyry Copper Co. to the Inspiration Consolidated Copper Co. was made last week at a meeting of the stockholders of the former company. It is reported that the price agreed upon by the two companies is \$1,000,000. Nearly 2,000,000 shares of stock were represented at the meeting, and it was stated that only 5000 shares were recorded as being opposed to the sale.

Jerome.—Rich copper-gold ore has been found by John Pritt, lessee of the Gary Eagle mine of the Empire Mining Co., 14 miles north-east of Parker. It is reported that the ore will assay 40% copper and \$25 gold per ton.

Kingman.—Favorable developments in the C. O. D. and Katherine mines are reported. Several hundred thousand dollars have been spent developing and equipping the C. O. D. property. A small tonnage of rich silver ore is being milled. The Katherine mine nearby contains gold ore, of which approximately \$2,000,000 is said to be blocked-out.

Miami.—Net operating profits of \$2,888,479, after taxes and depreciation, but before depletion, resulted from 1920 operations of Miami Copper Co. This is about \$4 per share, against dividends of \$2. Miami produced 55,581,328 lb. of copper in 1920 at a cost of 11.90c. per pound, exclusive of depletion. This was secured from about 1,800,000 tons of ore. There was added to reserves 1,400,000 tons of ore, making reserves on December 31 last 10,700,226 tons. Low-grade ore remained at 36,000,000 tons averaging 1.06% copper, while mixed sulphides and oxides held at 6,000,000 tons.

With contracts calling for delivery during the next few months, and with little or no unsold copper on hand, Miami company continues to operate at a time when practically all other large producers have shut-down.

Oatman.—The recent decision of Judge Bollinger of the Superior Court of Mohave county in the Tom Reed-United Eastern apex litigation awarded the United Eastern all of the Big Jim vein and the part of what is known as the Sideline vein lying within the side-lines of the Big Jim claim. The Tom Reed Gold Mines Co. is entitled to the part of the same vein lying within the vertical lines of the side-lines of the Gray Eagle claim, which belongs to the Tom Reed company.

Materials for construction work prior to sinking the new shaft of the Oatman Revenue are arriving. The present plan is to sink a vertical shaft which is expected to cut the vein at the 100-ft. level from which point lateral development will be started. The Oatman Revenue is located in the Union Pass district and is but a short distance from the

Sheeptrail and Minnie claims which have produced rich ore in the past.

Tombstone.—Following the announcement of the closing of the Copper Queen smelter at Douglas, lessees at the Bunker Hill mines commenced cleaning up their stopes and 40 cars of ore were shipped during the first 10 days of the month. It is probable that arrangements will be made whereby one of the local milling companies will treat a large quantity of low-grade ore pending the re-opening of the smelter.

CALIFORNIA

Allegheny.—The Rainbow mine is to be re-opened. R. A. Bedford, superintendent of the North Star mine at Grass Valley, has had supervision of the installation of machinery.

Grass Valley.—The mine on the Mulcahy ranch, managed by L. M. Dull, is producing ore that is being milled at a profit. The ore nearest the surface was treated in the small

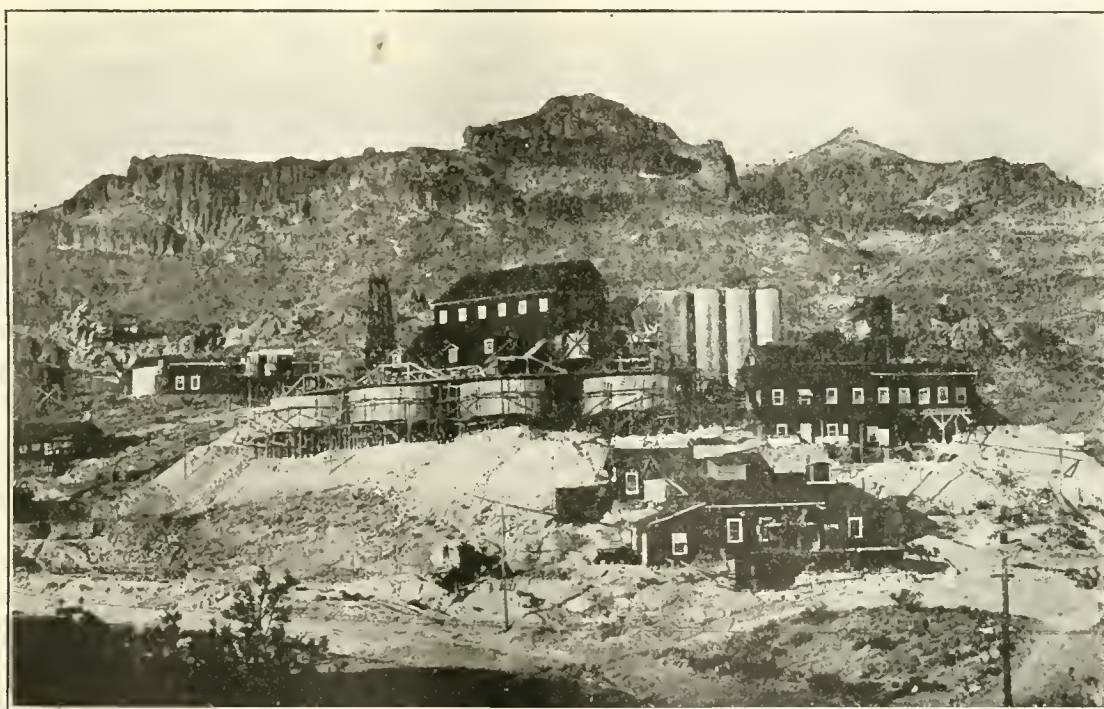
Ubehebe.—The ore on the 60-ft. level of the Arrowhead Rico has been exhausted and shipments from the mine have been stopped. A raise is now being driven from the lower tunnel in a 2-ft. width of \$100 ore.

COLORADO

Aspen.—The Smuggler Leasing Co. is shipping steadily. The lime content of the ore is around 46%; the high lime-content obtains a low smelting charge, permitting the marketing of a low-grade silver ore.—Other leading producers of the district are the Millinee, the Spar Con. M. & M. Co., the Hunter Creek Leasing Co., and the Newman M. & M. Co., each of which is shipping at the rate of one car per week.

Belden.—The Empire Zinc Co. continues large shipments from its iron-silver mines here.

Blende.—Work on the zinc-oxide unit continues, but the remainder of the plant is entirely shut-down.



The Tom Reed Mill at Oatman, Arizona

flotation plant, but free-milling ore has been found at greater depth.

Oakdale.—The Yankee Hill Gold Mining Co. is to be re-organized in order to make possible the development of valuable dredging land on the Stanislaus river. The company's dredge broke away from its anchorage three months ago and is now resting on dry land. L. D. Gilbert has been appointed trustee for the company.

Sierra County.—The Mount Alta mine was recently examined by Frank L. Sizer in behalf of the Jim's Divide Mine Co. The developed reserves of payable gravel are said to be sufficient to maintain operations for two years.

Sutter Creek.—At the Central Eureka mine concrete bulkheads and fire-doors have been completed. The south drift from the 3350-ft. level has entered green talc, which is thought to indicate the proximity of ore. This drift is being run to prospect a portion of the South Eureka land now under option to the Central Eureka.—Unwatering of the deepest part of the Argonaut mine is progressing.—The Idaho-Maryland company is enlarging its scope of operations. Lessees in the upper levels are supplying ore to keep the 20-stamp mill in operation.

Blackhawk.—The Silver Mountain Mining Co. has completed sinking an additional 50-ft. lift in its main shaft. Ore shows all the way. The shaft is to be sunk another 50 ft. before drifting is started. The company has leased the Wheeler tunnel and a cross-cut will connect with the Silver Mountain shaft. The company has also acquired the Brooklyn group in the gold district of Gilpin county and has started development.

Boulder.—Returns from a carload shipment by the Nil Desperandum Mines Co. from its property at Sunshine brought settlement of \$870 net. M. S. Brandt, manager, is putting ore mined in the No. 1 winze in the office safe. It runs as high as 700 oz. gold and 1100 oz. silver. The seam is one inch thick. The company plans construction of a 100-ton mill to treat the low-grade product of the property.

Breckenridge.—Lessees in the Missouri mine have ore in the bins waiting for the roads to open. This includes three cars of lead-carbonate ore containing both silver and gold. The ore will be shipped to the A. V. smelter at Leadville.—Brooks Snider lessees continue shipping a good grade of gold ore and are also sacking rich silverbearing quartz.

Cripple Creek.—March production totaled 46,766 tons,

with an average value of \$12.72 per ton and gross value of \$594,608. Of this tonnage the Golden Cycle mill, at Colorado Springs, treated 24,450 tons of \$16 ore; the Independence mill, Cripple Creek, 20,306 tons of ore averaging \$5.09, and Smelters, 2000 tons of \$50 ore.

Central City. Shipments continue from the Frontenac and the Notaway.

Durango.—At the Ten Broeck properties, near La Plata, mill-carpenters are engaged in preparatory work for a 50-ton plant, and the construction of buildings to accommodate an operating force of 200 men, an assay-office, and a mine-office.

The Beaucoup Metallic Mining Co., owning the Mountain Meadow group of 15 claims, 15 miles west of Durango, is about to resume operations. Supplies have been sent to the permanent camp.

Idaho Springs.—The Clear Creek & Gilpin County Ore Co. is shipping to the smelter at the rate of one car per week. —The Gem Mining Co. is mining good ore containing gold, silver, and lead. A crew of 80 men is engaged in development work. —Development work is under way on the properties of the Social Six Mining Company.

Kokomo.—The Modern Mines Co., financed by Leadville operators, has opened up a vein 4 to 5 ft. wide in the Whitley tunnel, assaying 14 oz. silver, 20.9% lead, 19.8% zinc, and 0.22 oz. gold. The company is installing K & K flotation machines in its mill, preparatory to local treatment of low-grade ores. —The Kokomo Mining Co. is preparing to resume operations on its Pearl Consolidated group, on Chalk mountain.

Lake City.—Mining activity continues. The Fanny Fern Mining Co. is shipping at the rate of six cars of ore per month. The Excelsior-Broker group is being developed, and the Ute and Gladiator mines are shipping.

Ouray.—A large body of mill-ore is reported blocked-out in the Barstow mine near Ironton. The vein, originally 17 ft. wide, has narrowed down to 5 ft. of higher grade ore. The lessees have been working all winter and will commence shipments of ore to the Barstow mill this summer. The working force was recently increased.

Pueblo.—The American Smelting & Refining Co. is about to shut-down its smelter here, although the lead-manufacturing plant may be continued for a period. The shut-down is due to a great extent to the closing down of the zinc-plants of Oklahoma, the Bartlesville Zinc Co., the National Zinc Co., and the U. S. Zinc Co. plants at Sand Springs and Henrietta, and the plant at Blende. This resulted in a large tonnage of residues being cut off from the Pueblo smelter. The shut-down by the Sunnyside M. & M. Co. had resulted in the loss of a large supply which was needed in smelting operations. The A. S. & R. Co. arrived at the conclusion that there was not sufficient production to warrant the operation of three smelters in the State, and after study of the situation decided to divert all shipments from the Pueblo smelter to the Arkansas Valley plant at Leadville, owing to the fact that the greatest tonnage of ore was being produced in the Leadville district.

Red Cliff.—Development continues on the Ground Hog, Liberty, and Wyoming Valley mines under the direction of Dismont Bros. Shipments are being made.

Romley.—The Mary Murphy mine is shipping steadily to the Leadville smelter.

IDAHO

Coeur d'Alene.—At the Lookout Mountain mine on Pine creek a new bunk-house has been built to accommodate 35 men. A compressor has been installed and is ready for service. It is the intention to continue development from the lower adit which is now in 425 ft., and which should within a short distance cut the vein that was found near the surface. Assays from the open-cuts on this vein showed 56%

lead and 22 oz. of silver. —The Reed Level Mining Co. is installing an electric motor, a three-inch Krogh pump, and other equipment to pump back through its flotation plant 15,000 tons of slime that was confined below the mill. This material is from operations previous to the use of flotation. Four cars of concentrate are shipped monthly. Shortly the company will double its present capacity.

Work on the Sterling Silver property on Big Creek is progressing. Five men are driving a cross-cut to reach the vein that is showing in the open-cut and upper workings. This will require 200 ft. more of cross-cutting. —A contract for driving 100 ft. of adit has been let by the Caribon Mining Co. The object of the company is to finish the main working tunnel, which is now in 150 ft. and 480 ft. under the vein. Two orebodies have been uncovered 150 ft. apart. They dip together, leading to the belief that they join to form one large orebody. Assays show 57.3% lead and 15 oz. silver.

Reports from lessees at the Yankee Boy mine of the Sunshine Mining Co. state that ore obtained in the lease recently assayed 1775 oz. silver. It is said that this is the highest assay ever received on ore from the mine. The ore is being treated at the Bunker Hill & Sullivan smelter.

Settlement of the Marsh-Hecla-Federal mining suit was recently made. At the conclusion of the meeting the officers made the following statement which contains the gist of the agreement:

"This settlement involves a payment to the Marsh company at \$112,500 in cash, and in addition thereto the Marsh receives certain valuable concessions including tunnel rights for exploring the 'Russell' vein easterly through Marsh ground, and also the release of the American Smelting & Refining Co. ore contract against all the ground owned by the Marsh company."

Business conditions in Kellogg have been affected little by the period of depression throughout the country. The prosperity is attributed largely to the policy of the Bunker Hill & Sullivan Mining company in continuing production of lead and silver ores at a steady rate rather than reducing crews and output during periods of low prices and unsteady markets. The Bunker Hill is employing in the mine one of the largest crews in years. Twenty men are at work rebuilding the east mill, which was burned last summer. The new mill will have a capacity of 500 tons daily. A modern power plant has been completed.

The Amazon Dixie Mining Co. has completed the electrification of its mine and equipment. The installation includes a nine-mile high-voltage electric-power line through the Lolo forest to its property; one 18-ton and one 5-ton transformer near Taft; one 100-hp. electric hoist with motor; one 150-hp. electric pump and several smaller pumps; one 75-hp. electric motor for two compressors; placing 3000 ft. of electric cable transmitting power to underground works, and installation of 15,000 ft. of electric wiring.

Mackay.—At the Doughboy mine a drift on the 350-ft. level has followed a 5-ft. vein of galena ore for 350 ft. The ore is said to average 70 oz. of silver and 50% lead, according to F. C. Armour, who is interested in the property. The inclined shaft is being sunk to the 450-ft. level.

MICHIGAN

Houghton.—The Calumet & Hecla 'reclamation' plant was shut-down April 1 along with the mines. The smelting works at Hubbell will close shortly, just as soon as the accumulated supply of mineral is cleaned up. Suspension of production is to be complete. It will be necessary to operate pumps in all the mines to keep openings in condition but timbering will be done only from time to time as it is needed. Whether work will be continued in the Calumet & Hecla haulage drift, which is being driven at the 81st level of the conglomerate shafts, and in the cross-cut from the 81st level

of the Red Jacket shaft to intersect the Kearsarge lode, has not yet been determined. Geological research, which is being conducted by a number of eminent geologists, will go on. Experts have been employed in this investigation for a year and it is estimated the task will require at least two more years. Satisfactory progress is reported. It is hoped to determine, if possible, the origin of copper ore. It involves a thorough study into all existing theories, some of which may be overturned. If successful in making definite deductions the result will be of great value to the district inasmuch as it will eliminate to some extent the hit or miss methods of finding new deposits.

Everything reasonable will be done to make the burden of unemployment as light as possible. The men will continue to live in the company houses, rent and medical service free, and many of them will be given employment in road work in both Houghton and Keweenaw counties. Undoubtedly a large number will leave for the industrial centres. There is a feeling here that the period of the suspension will not be for more than three or four months although there is absolutely no stated time for the re-opening of the mines.

The Quincy Mining Co. has entered upon a policy of further curtailment and retrenchment. Wages have been cut another 10% and the night shift at No. 6 shaft has been discontinued, letting out about 100 men. No. 6 shaft is one of the mine's largest producers and the curtailment here will reduce the daily shipments several hundred tons. It is likely other steps will be taken to reduce expenses to the minimum. Under the new plan of operations not much more than 2400 tons daily will be sent to the mills and only one furnace will be used at the smelter.

Copper Range will not dismiss any of its men, aiming to keep its organization intact. The recent cut in wages of 50c. per day for miners, trammers, and laborers, with a proportionate reduction in salaries, is about the only retrenchment step that will be taken. There has been a considerable labor turnover at the Champion, Baltic, and Trimountain mines. The Champion, however, has a larger force than for some months and it is being reflected in larger rock shipments.

Mohawk and Wolverine also will continue to operate as usual. Both of these mines have made further wage-cuts and will keep open as long as possible. An appeal has been issued to the men to put forth all efforts in increasing efficiency.

Victoria continues to employ about 100 men. No sinking, drifting, or stoping is being done. Work is confined to taking out 'rock' broken down in the stopes. This 'ground' is running only 7 to 10 lb. per ton.

MONTANA

Butte.—The recent shut-down of the copper mines is working great hardship on the business men of Butte. Mining is the only important industry for a town of some 50,000 people, so that the entire suspension of production, following a long period of reduced operations, is disastrous for the merchants of the city.

During 1920 East Butte recorded an operating profit of \$208,636, after deducting \$51,597 for depreciation and depletion. This report is one of the few exceptions to the general rule of an operating loss.—So far the Davis-Daly company has not decided to suspend operations. Both the Colorado and Hibernia mines are being operated regularly.

Elkhorn.—W. R. Allen, president of the Boston & Montana Development Co., states that the necessary material for the completion of the company's new mill is on the ground. It is estimated that 1,000,000 tons of 2% copper ore, averaging 5½ oz. silver and containing some lead and gold, has been blocked-out.

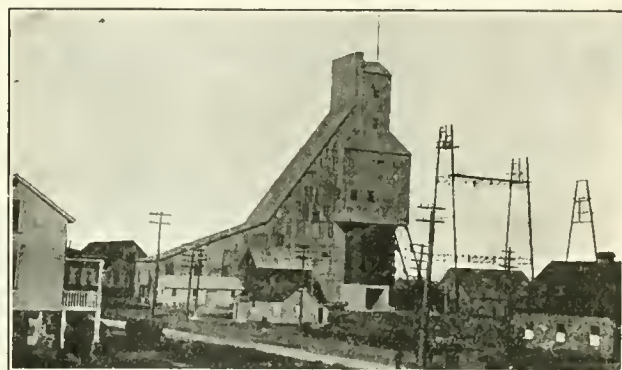
Helena.—According to Roland King, an engineer interested in the Sterling Mining & Milling Co., the Mike Horse

property 50 miles north-west of here will be re-opened. The property consists of 15 claims almost directly on the Continental Divide. The mine is an old silver-lead producer.—Rich gold ore has been found in the Shannon mine at Marysville. The vein is 15 ft. wide and is opened on the 400-ft. level. The Shannon is one of the principal producers of the Barnes-King Development Company.

Philipsburg.—The Two Per Cent mine has been optioned to J. F. Russell, senator from Hawaii, and associates. F. G. Loomis, manager of the mine, has sunk a shaft to the 500-ft. point and expects to find better silver ore as additional depth is gained.

Race Track.—According to Miles Blunt, the new 150-ton concentrator at the Champion mine is operating successfully. A filter for the proper drying of concentrate is to be installed. The 350-ft. level is now being drained and only 250 ft. of shaft is yet to be unwatered; 65 men are employed at the mine and mill.

St. Regis.—Gustave Wolf has run an 1100-ft. adit at his mine near here. The ore is similar to that mined in some



No. 5 Shaft, Oceola Con. Co., at Calumet, Michigan

of the properties in the Coeur d'Alene district. Samples have assayed 3.7% copper, \$4.60 in gold, and 6 oz. of silver.

NEVADA

Goldfield.—When the Red Hill shaft, which is to be sunk from the 600 to the 800-ft. point, is 675 ft. deep it will enter the fault striking east through the Florence and Red Hill. An ore-shoot has never been found south of this fault. A cross-cut will be driven east on the north side of the fault from the bottom of the shaft and a cross-cut that has been driven 300 ft. west on the 500-ft. level, on the south side of the fault, will be continued. This west cross-cut is 250 ft. south of the fault. Little quartz has been found in work east of the shaft, but the west cross-cut has opened 10 to 15-ft. widths of quartz. It is reported that the Florence is to cross-cut from east to west the entire ground of that company at 1000 ft. south of the fault. The east vein in the Cracker Jack has been drifted in for 80 ft., the west vein has been drifted in for 90 ft., and the cross-fracture between the two has been opened for its entire length of 40 ft. A 30-ft. raise at the intersection of the east vein and the cross-fracture is in \$25 ore and a 20-ft. raise at the north end of the west vein is in 2½ to 3 ft. of \$50 ore. Sixty feet south of this raise another will be driven.

Hornsilver.—The orebody on the 580-ft. level of the Orleans is being broken for a width of 9 ft., the ore assaying \$30 to \$2 for this width. The shoot has been opened for a length of 26 feet.

Johnnie.—The finding of what is said to be a rich placer field two miles east of here has caused a rush into the district from Tonopah. The proverbial nuggets the size of a pea and larger have been found. Little work has been done.

Klondyke.—The Knox shipped last month 400 tons of ore of an average value of \$14.75. Fifteen leased or sub-leased blocks are being developed in the district and shipments have been made recently or are nearly ready from eight leases. The average grade of ore is \$15 to \$30 and several shipments have averaged \$35 to \$50.—Easterners, as the result of an examination made two months ago, have taken an option on the Original Klondyke, now being worked by Edwards and Maloney under a lease. The option is held by the men who are interested in the new Silver Horn district.

Pewee.—The Standard Metals mill has been started. Ore is coming from the two orebodies on the 300-ft. level, where one shoot has been opened for a length of 110 ft. and an average width of 12 and the other for a length of 130 ft. and an average width of 10.—Machinery has been ordered for sinking another 100 ft. in the 160-ft. shaft of the Paymaster.—The Black Panther shaft is being sunk to the 500-ft. level.

Silver Horn.—Engineers for big Eastern interests are investigating this newest Nevada silver district, which owes its prominence to rich ore found on and near the surface of the Silver Horn and Silver Dale groups and to 10 to 25-ft. widths of 20 to 30-oz. ore in the same groups. A townsite has been laid out. Four companies are working in the district, shipments are being made, and the population of the town is estimated at 200. The deepest shaft is 260 feet.

Sprucemont.—A 9-ft. width of ore assaying 27% lead and 40 oz. silver is reported to have been opened in new work at a depth of 500 ft. in the Spruce Menarch.

Tuscarora.—A new mill is to be erected here, according to Z. F. Wheeler, on a property recently leased by mining men from Reno. The property of the Holden Mining & Milling Co. has been taken over and will be developed by a group of Eastern capitalists. A third company will sink the shaft of the Grand Prize mine to greater depth. The present 785-ft. shaft produced millions in silver in the 'seventies.

UTAH

Alta.—Announcement of the intention of the South Hecla Mining Co. to start drilling for oil on the San Rafael Swell has been made by George H. Watson, president and general manager. The company, according to Mr. Watson, has acquired a seven-eighths interest in 1600 acres, favorably situated. During the year 1920, the company shipped a total of 3581 tons of ore, the metal content of which was as follows: 56,542 oz. of silver; 161 oz. of gold; 329,836 lb. of lead; and 12,395 lb. of copper.

Eureka.—Ore shipments from the district for the week ended April 2 showed a slight decrease as compared with the previous week: 150 cars were shipped as compared with 174 for the week preceding. The Tintic Standard shipped 57 cars; Chief Consolidated, 25; Iron King, 17; Dragon, 9; Iron Blossom, 8; Eagle and Blue Bell, 7; Victoria, 5; Swansea, 4; Grand Central, 4; Centennial-Eureka, 3; Bullion Beck, 3; Genini, 2; Mammoth, 2; Gold Chain, 2; Colorado, 1; and Sunbeam, 1.

Notwithstanding the closing of the Garfield smelter, the Tintic Standard will continue to ship the same amount of ore as it has during the past few months, according to E. J. Raddatz, manager. Mr. Raddatz states that he has already arranged for a market for most of that which was formerly shipped to the Garfield smelter. Part of it will be treated in the company's new mill and the remainder will be sent to the Murray and the Midvale smelters. The report of the Tintic Standard Mining Co. for the fourth quarter of the year 1920 states that a total of 1833 ft. of drifting and raising was done; ore shipments totaled 26,697 dry tons with a gross assay-value of \$1,306,880. Smelter deductions and treatment charges were \$562,001; freight, \$85,854; mining, development, and improvements, including expenses on the

new mill, were \$327,136, leaving, net to the company, for the fourth quarter, \$33,188.

An accident at the Chief Consolidated mine which resulted in the tearing out of wall-plates and other heavy timbers in No. 1 shaft caused a suspension of underground operations for two weeks following April 2. Heavy mine-cars, that were being hoisted at the time of the accident, were so tightly wedged in between the cage and the shaft timbers that an acetylene torch had to be used to cut the metal into small pieces.

Park City.—Production of Park City mines for the week ending April 1 increased to a total of 1816 tons as compared with a total of 1639 tons for the week preceding. Production was as follows: Judge Allied companies, 914 tons; Silver King Coalition, 463 tons; and Ontario, 438 tons.

A discovery of considerable importance has been made in a raise from the Spiro tunnel of the Silver King Consolidated Mining Co., according to Harry A. Lee, consulting engineer and assistant manager. This ore, assaying \$2 in gold, 62 oz. in silver, and 12.98% copper, was found on a ilme-quartzite contact at a point 110 ft. from the head of McGregor raise driven 180 ft. above the tunnel-level. At a point about 13,500 ft. from the portal of the tunnel an extensive porphyry intrusion, called the McGregor dike, was cut. In order to prospect a major fissure system which cut the tunnel at this point the McGregor raise was started. When the ore was first entered it was only a few inches wide. However it widened rapidly until at last report from the mine about three feet had been opened up. The Spiro tunnel, started about five years ago, has cross-cut the formation for about 15,000 feet.

Directors of the Silver King Coalition Mines Co. declared a dividend of 15c. per share payable May 1. This disbursement of \$182,415 will bring the grand total of dividends paid by the company up to a total of \$15,380,975. Payment of dividends was interrupted several years ago pending the settlement of the Silver King Coalition-Cenklung litigation, recently decided in favor of the Silver King. Tentative plans for the erection of a new mill to replace the old concentrator destroyed by fire a short time ago include a steel milling plant with a capacity of 450 tons per day, the construction of which will cost approximately \$200,000.

WISCONSIN

Platteville.—The continued pressure imposed upon operators by low markets for both zinc ore and lead ore had its effect and further disintegration of the mining forces in the Wisconsin field was noted during March. The Connecting Link Mining Co., of Cuba City, which through the entire period of depression has been enabled to market a portion of its output of zinc concentrate with the National Zinc Ore Separators, suspended on the first of the month. The Block-House Mining Co., of Platteville, also shut-down both mine and mill. At the time the men were laid off there was stored in bin 1500 tons of crude concentrate and 800 tons of electrically treated blende. Only two zinc-ore mines were left at the close of the month actually engaged in production for marketing purposes, these being the Yewdall mine at Livingston and the North Unity at Day Siding, both owned and operated by the Vinegar Hill Zinc Co. Others were producing but the ore was being stored.

Among these are the McKinley mine at Dodgeville; Rodhams mine, at Shullsburg; Middie, at Benton; and Penna-Benton, at New Diggings.

The ore from the Vinegar Hill mines was delivered to the National Zinc Ore Separators, at Cuba City, where it forms the base for sulphuric-acid manufacture. Deliveries of acid continue to be made to far eastern points, and it is quite probable that this ore-production will be maintained for the purpose of acid manufacture indefinitely.

By reason of the nearness of Wisconsin zinc mines to

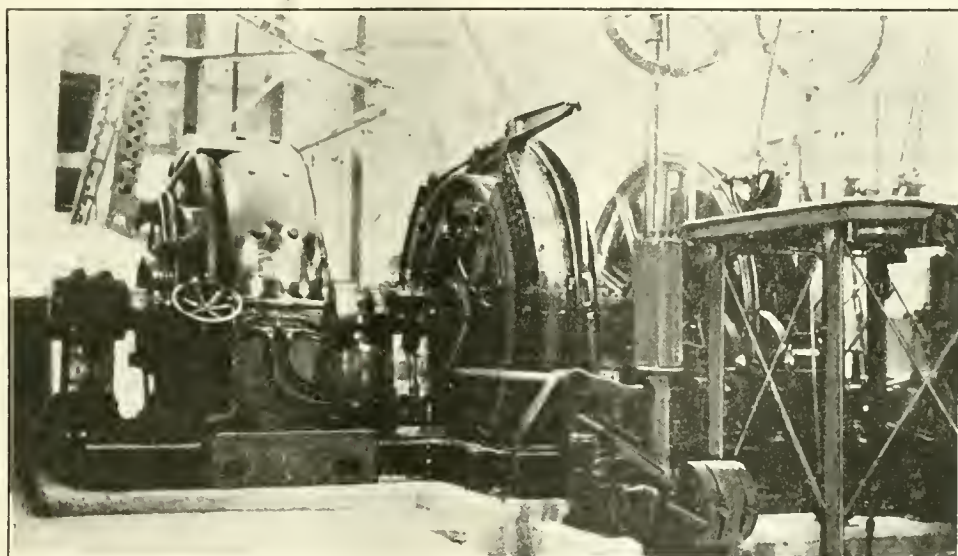
smelters, in the coal regions of Illinois, there is an advantage in freight-rates amounting to about \$5 per ton, as compared with the Joplin district, so that while Joplin quotations on standard blende held at about \$22 per ton, base, the top price registered for the month of March on 60% blende was \$27. The principal shippers for the month were the National Ore Separators, the Mineral Point Zinc Co., and the Block-House Mining Co.

The gross recovery of crude concentrate for the month amounted to 3520 tons; of this but 2172 tons was delivered to separating plants, the remainder being tacked on to an already exceedingly heavy reserve. It is conservatively estimated that there is held at the close of March about 20,000 tons of crude zinc concentrate; 4000 tons of high-grade separator blende; 3500 tons lead ore; and 30,000 tons iron pyrite and pyrite residue.

No lead ore was marketed during March. The price fell as low as \$40 per ton, 80% metallic content. At the Rodhams mine alone, there is held in reserve 1500 tons of lead ore. It is now held the price of lead ore will hardly go

on its investment, and it would gladly rent it to anyone offering a reasonable return. He believed Anyox was the only copper property in the western hemisphere that is operating at anything like capacity. At the present time 1130 men are on the payroll, and, although there has been another cut of 25c. in the wage-scale in accordance with the agreement entered into last December, labor conditions were never better. Living-cost for married men has dropped 25% since the beginning of last December.—The Outland Silver Bay group, three miles from the Hercules, in the Portland Canal district, will be worked this summer by a Seattle syndicate headed by F. C. Outland. Surface-stripping has been done on the property and a good surface showing has been made.—The Taylor Engineering Co. has under consideration the erection of a gravity and flotation concentrator at the Dolly Varden this year.

Slocan.—With the exception of development work, which is being done at the Silversmith, the Bosun, and a few other mines, and work that is being done by lessees, mining is at an exceedingly low ebb in this district. Last week, lessees



Underground Hoisting-Station in the Silver King Coalition Mine at Park City, Utah

above \$45 per ton under the best of circumstances. While no shipments were made in March some deals were closed.

BRITISH COLUMBIA

Ashcroft.—Carl Elingsen and Thomas Lick, prospectors, have made a find in a dry digging about eight miles from Smithers and 100 ft. from the Thompson river. They exhibited some \$400 worth of nuggets, the largest weighing 1½ oz. The claim has been worked from the surface to a layer of hard-pan, about four feet thick. The gravel in this district has been worked before, but this bench appears to have been overlooked.

Prince George.—The Dominion Trading & Transportation Co., Ltd., has shipped a carload of placer-mining machinery to Hudson Hope, where the company owns a large tract of ground. R. D. Featherstonhaugh is manager for the company.

Prince Rupert.—H. S. Munroe, general manager for the Granby Consolidated M. S. & P. Co., passed through here on his way to Anyox, after making an inspection of the company's other properties in the Province. Mr. Munroe stated that the company's Grand Forks property would be closed entirely within a month, that all the removable machinery had been taken away, and that it was extremely improbable that the company would ever use the plant again. The Cassidy colliery, he said, was not paying the company 5%

sent two cars of ore from the Standard mine to the Bunker Hill & Sullivan smelter at Kellogg.

ONTARIO

Cobalt.—Operations have been resumed on the Keeley Silver Mines in South Lorrain. The pumps are running and three machines will be started just as soon as men can enter the lower levels. The 20-stamp mill will be started soon after underground work commences. Ore is said to average from 40 to 90 oz. silver per ton. —Since November, the La Rose has shipped 25 tons of high-grade, in addition to the usual tonnage of mill-ore, from its University property. The high-grade has averaged 3200 oz. of silver per ton.

The total silver production from Cobalt during March amounted to approximately 500,000 oz. and was the lowest for any month since 1906, with the exception of periods during strikes. Present curtailment, owing to the poor market for silver, amounts to about 60%. Mining men believe that costs are gradually declining, while the price of the metal seems to have reached its lowest point.

The National Mining Corporation, of London, has two diamond-drill machines operating on the White Reserve mine, at Maple Mountain.—The Kerr Lake Mining Co. has completed the purchase of the Hargraves property, and has extended operations across the boundary from the Kerr Lake to the Hargraves.

PERSONAL

The Editor invites members of the profession to send particulars of their work and appointments. The information is interesting to our readers.

W. J. Barnett is in Spain.
 Ralph Arnold is in London.
 Benjamin F. Tibby is in San Francisco.
 E. K. Larsen, from Salt Lake City, is here.
 H. R. Layng is here from Eureka, Nevada.
 H. DeC. Richards is at Needles, California.
 W. Macdonald was in San Francisco recently.
 Howard D. Smith has returned from the East.
 Robert A. Kinzie has returned from McGill, Nevada.
 J. B. Richardson has returned from Bolivia to London.
 J. Mackintosh Bell has returned from London to Ontario.
 Horace V. Winchell passed through San Francisco this week.
 S. H. Dolbear has returned to San Francisco from New York.
 Seeley W. Mudd has returned from Berkeley to Los Angeles.
 Lester W. Strauss has returned from Bolivia to Valparaiso, Chile.
 L. O. Kellogg, of Guayaquil, Ecuador, is at Carmel, California.
 G. Howard Birch, of New York, has gone to Dan Creek, Alaska.
 Robert Musgrave is on his way from Shanghai, China, to England.
 Thomas J. Jones has returned to San Mateo from Spain and Algeria.
 W. H. Crago has returned from the Belgian Congo on a visit to Duluth.
 Percy R. Middleton was here last week; he has returned to Anyox, B. C.
 C. W. Corfield, electrical engineer for the Utah Copper Co., is in New York.
 George S. Rice is in Arizona making an investigation into mine ventilation.
 Henry I. Altschuler has returned to San Francisco from Cerro de Pasco, Peru.
 William Hosking has been elected president of the Cornish Institute of Engineers.
 J. B. Tyrrell, of Toronto, is engaged in professional work near Calgary, in Alberta.
 W. H. Howard, of Salt Lake City, was in San Francisco on his way from Los Angeles.
 J. Nelson Nevins, of Los Angeles, has been examining mining property in Butte county.
 J. F. Foran is now superintendent of mines at Cerro de Pasco, in succession to C. O. Stee.
 Sherwood Aldrich, president of the Ray Consolidated Copper Co., is traveling in the Orient.
 Walter E. Gaby has been appointed geologist to the Santa Gertrudis company, at Pachuca, Mexico.
 Morton Webber and his assistant, W. T. Benson, are examining a mine in Butte county, California.
 Charles W. Merrill sailed from New York on April 7, having been called to London by the illness of his daughter.
 Bradley Stoughton, secretary of the American Institute of Mining and Metallurgical Engineers, was at Butte last week.

Edward Thornton is going to Mexico to assume the management of the Progreso Mining Co. at Saqui, Sonora, Mexico.

Robert McE. Doble is consulting engineer for the Metals Exploration Co., with offices at 201 Fourteenth street, Denver.

G. W. Wooster, treasurer, and G. L. McNichol, purchasing agent, have resigned after 22 years service with the Granby company.

N. J. Evered is in Toronto, having resigned from the management of the Davidson Consolidated Gold Mines, Ltd., South Porcupine.

Hjalmar E. Skougor has left New York on a professional trip to England, France, Belgium, Holland, Germany, and the Scandinavian countries.

Collin G. Plink, of South Yonkers, New York, who had organized and directed the research laboratories of the Chile Exploration Co., has resigned.

A. H. Heller has become a partner in the firm of David E. Day and Roland B. Day, with offices in the Hobart Bldg., San Francisco, and at Washington.

Stanly A. Easton, manager of the Bunker Hill mine and smelter, was here last week from Kellogg, Idaho. He attended the convention at Portland.

Henry Hanson has gone to Keeler, California, in connection with the erection of a 50-ton concentrator which he has designed for the Cerro Gordo Mines Co.

Letson Balliet, who discontinued mining to become efficiency engineer for the Moore Shipbuilding Corporation during the War, has resigned to again practice as a consulting engineer.

G. D. Delprat has resigned as general manager for the Broken Hill Proprietary Mining Co., and is succeeded by Essington Lewis. Mr. Delprat becomes consulting engineer to the company.

Edwin Ludlow, president of the American Institute of Mining and Metallurgical Engineers, attended the International Mining Convention at Portland last week, and went subsequently to Butte, Montana.

L. Ehnborn is making a geological examination of the Aguila and Vivoras properties in the Hostotipaquillo district for the Rey Mining Co., and will later take charge of the development and operation of these properties.

Frederick B. Hyder has resigned as valuation engineer of the Income Tax Unit, Bureau of Internal Revenue, to resume the practice of mining and metallurgical engineer, with offices at 460 Montgomery street, San Francisco.

J. O. Elton, of Great Falls, an alumnus of the University of Idaho, was made the recipient of an honorary degree from his Alma Mater during the recent inauguration of Dr. A. H. Upham as president of the University. The degree was conferred in recognition of Mr. Elton's work in the hydro-metallurgy of zinc.

The following is a revised list of the valuation engineers of the Natural Resources Division of the Internal Revenue Bureau's Income Tax Unit: For metals: Orr R. Hamilton, William H. Cragne, Robert C. Davis, F. T. Donahoe, F. T. Eddington, Albert W. Gaumer, Charles C. Griggs, John A. Grimes, William H. Harrison, Samuel P. Hatchett, William H. Kolbe, John Seward, Alexander R. Shepherd, William Huff Wagner. For oil and gas: N. R. White, Russell Beall, Robert W. Brown, Walker S. Clute, William S. Cullen, Albert H. Fay, Silas L. Gillan, Samuel M. Greenidge, Samuel A. Gutberlet, Burr B. McWhirt, Percy L. Ports, Oscar H. Reinhold, Raymond Richards, Donald D. Riddle, Lyon F. Terry, Ralph W. Wardwell, Roger F. White. For coal: Godfrey M. S. Tait, L. W. Atkinson, T. H. Barrett, F. L. Clemens, C. Terry Durell, Edwin F. Lines, E. J. Mahan.

THE METAL MARKET



METAL PRICES

San Francisco, April 12

Aluminum-dust, cents per pound.....	75
Antimony, cents per pound.....	7.50
Copper, electrolytic, cents per pound.....	13.00
Lead, pig, cents per pound.....	4.50—5.50
Platinum, pure, per ounce.....	\$75
Platinum, 10% iridium, per ounce.....	\$105
Quicksilver, per flask of 75 lb.....	\$45
Spelter, cents per pound.....	7.50
Zinc-dust, cents per pound.....	12.50—15.00

EASTERN METAL MARKET

(By wire from New York)

April 11.—Copper is quiet and steady. Lead is inactive but firm. Zinc is lifeless but steady.

SILVER

Below are given official or ticker quotations for silver in the open market as distinguished from the fixed price obtainable for metal produced, smelted, and refined exclusively within the United States. Under the terms of the Pittman Act such silver will be purchased by the United States Mint at \$1 per ounce, subject to certain small charges which vary slightly but amount to approximately three-eighths of one cent. The equivalent of dollar silver (1000 fine) in British currency is 46.65 pence per ounce (925 fine), calculated at the normal rate of exchange.

Date	New York	London	Average week ending	Cents	Pence
Apr. 5.....	56.87	33.00	Feb. 28.....	55.67	32.22
" 6.....	57.62	33.25	Mch. 7.....	54.18	31.52
" 7.....	58.12	33.50	" 14.....	55.12	32.04
" 8.....	57.62	33.37	" 21.....	56.69	33.00
" 9.....	58.12	33.62	" 28.....	57.69	33.45
" 10 Sunday.....			Apr. 4.....	56.92	32.98
" 11.....	59.62	34.50	" 11.....	58.00	33.54

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.	101.12	132.77	65.95	July	106.36	62.04	....
Feb.	101.12	131.27	59.55	Aug.	111.35	96.23	....
Mch.	101.12	125.70	56.08	Sept.	113.92	93.66	....
Apr.	101.12	119.56	....	Oct.	119.10	83.48	....
May	107.23	102.69	....	Nov.	127.57	77.73	....
June	110.50	90.84	....	Dec.	131.92	64.78	....

COPPER

Prices of electrolytic, in cents per pound.

Date	Average week ending	Cents	Pence
Apr. 5.....	12.50	Feb. 28.....	12.67
" 6.....	12.50	Mch. 7.....	12.43
" 7.....	12.50	" 14.....	12.16
" 8.....	12.50	" 21.....	11.87
" 9.....	12.50	" 28.....	12.15
" 10 Sunday.....		Apr. 4.....	12.68
" 11.....	12.50	" 11.....	12.50

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.	20.43	19.25	12.94	July	20.82	19.00	....
Feb.	17.34	19.05	12.84	Aug.	22.51	19.00	....
Mch.	15.05	18.49	12.20	Sept.	22.10	18.75	....
Apr.	15.23	19.23	....	Oct.	21.66	16.53	....
May	15.91	19.05	....	Nov.	20.45	14.63	....
June	17.53	19.00	....	Dec.	18.55	13.18	....

LEAD

Lead is quoted in cents per pound, New York delivery.

Date	Average week ending	Cents	Pence
Apr. 5.....	4.25	Feb. 28.....	4.12
" 6.....	4.25	Mch. 7.....	4.06
" 7.....	4.25	" 14.....	4.04
" 8.....	4.25	" 21.....	4.00
" 9.....	4.25	" 28.....	4.00
" 10 Sunday.....		Apr. 4.....	4.39
" 11.....	4.25	" 11.....	4.25

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.	5.60	8.65	4.96	July	5.53	8.63	....
Feb.	6.13	8.88	4.54	Aug.	5.78	9.03	....
Mch.	5.24	9.22	4.06	Sept.	6.02	8.08	....
Apr.	5.05	8.78	....	Oct.	6.40	7.28	....
May	5.04	8.55	....	Nov.	6.76	6.37	....
June	5.32	8.43	....	Dec.	7.12	4.76	....

TIN

Prices in New York, in cents per pound.

	1919	1920	1921		1919	1920	1921
Jan.	71.50	62.74	35.94	July	70.11	49.29	....
Feb.	72.44	59.87	32.16	Aug.	62.20	47.60	....
Mch.	72.50	61.92	28.87	Sept.	55.79	44.43	....
Apr.	72.50	62.17	....	Oct.	54.82	40.47	....
May	72.50	54.99	....	Nov.	54.17	36.97	....
June	71.83	48.33	....	Dec.	54.94	34.12	....

ZINC

Zinc is quoted as spelter, standard Western brands, New York delivery, in cents per pound.

Date	Average week ending	Cents	Pence
Apr. 5.....	5.15	Feb. 28.....	5.20
" 6.....	5.15	Mch. 7.....	5.10
" 7.....	5.15	" 14.....	5.25
" 8.....	5.15	" 21.....	5.25
" 9.....	5.15	" 28.....	5.20
" 10 Sunday.....		Apr. 4.....	5.15
" 11.....	5.15	" 11.....	5.15

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.	7.44	9.56	5.86	July	7.78	8.18	....
Feb.	6.71	9.15	5.34	Aug.	7.81	8.31	....
Mch.	6.53	8.93	5.19	Sept.	7.57	7.84	....
Apr.	6.49	8.78	....	Oct.	7.82	7.50	....
May	6.43	8.07	....	Nov.	8.12	6.78	....
June	6.91	7.92	....	Dec.	8.69	6.03	....

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, according to quantity. Prices, in dollars per flask of 75 pounds.

Date			Mch.	29	46.00
Mch.	15	45.00	Apr.	5	45.00
"	22	45.00	"	12	45.00

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.	103.75	89.00	50.00	July	100.00	88.00	....
Feb.	90.00	81.00	48.75	Aug.	103.00	85.00	....
Mch.	72.80	87.00	45.88	Sept.	102.60	75.00	....
Apr.	73.12	100.00	....	Oct.	86.00	71.00	....
May	84.80	87.00	....	Nov.	78.00	56.00	....
June	94.40	85.00	....	Dec.	95.00	52.50	....

THE RAILROAD PROBLEM

Discussing the railroad situation, Edgar E. Clark, Chairman of the Interstate Commerce Commission, says in part:

Congress, in a farsighted way, endeavored to provide a governmental policy under which the country would be assured uninterrupted, efficient, adequate railroad transportation at reasonable rates; employees would be reasonably compensated and patrons would pay what the service is fairly worth. It may be doubted if many have comprehended the extent to which the Railroad Act projects itself and its influences into the future. Too much energy has been expended in criticizing what, at the moment, from superficial thought, seemed weaknesses in it, and there has been too little disposition to assist in laying the foundation for the super-structure that Act contemplates.

A large strong railroad system made up of main lines upon which traffic-density is heavy and of numerous feeder-lines upon which much of that traffic originates can afford better service at less cost than that same trackage divided into several independent companies with all their rivalries and differences of view. The Government asserts right to regulate the railroads, and that right is not challenged. The country needs strong, well equipped, well operated, prosperous railroads. It must be willing to pay what is reasonably necessary to have that service. Why should it not be rendered by large systems with component parts properly co-ordinated under a common policy rather than by a substantial number of weaker and, in some instances, impetuous systems, each with selfish interests and separate organization striving to promote those selfish interests? The new law contemplates consolidation into a limited number of large systems under which every reasonable degree of competition will be preserved. I wish it were possible to hope for consummation of that purpose at an early date.

Immediately following Federal control the railroads successfully moved a larger tonnage than had ever been moved. Capacity of the transportation machine was demonstrated. Serious interference resulted from labor difficulties, and later traffic fell off due to readjustment of industrial conditions. Financial results in recent months have been disappointing. Grave, and in many instances serious, losses have been experienced by producers and distributors. This has caused a good deal of impatience which has taken the form of demands for reductions in transportation charges.

Freight-rates are high. I have yet to meet a well-informed man who does not feel they can be made no higher as a revenue measure. Careful inquiry into some distressing situations discloses that utilization of products is prevented, not by freight-rates, but by economic conditions and perhaps manipulated markets. In November 1920 average ton-mile revenue of railroads of the United States was 75.7% higher than in 1913. Wholesale prices of commodities transported in large quantities averaged 107% higher than 1913, and in May 1920, 172% over 1913. Reference has been made to operating costs of railroads. Until the foundation has been laid for widening the margin between revenue and cost of earning it, it is difficult to find justification for an attempt at a general reduction in rates.

MONEY AND EXCHANGE

Foreign quotations on April 12 are as follows:

Sterling, dollars: Cable	3.92 3/4
" Demand	3.93 1/2
Francs, cents: Cable	7.18
" Demand	7.21
Lire, cents:	4.69
Marks, cents	1.66

Eastern Metal Market

New York, April 6.

General conditions are changed but slightly. Demand is still small and, while inquiry is better, it does not result in much business.

After a slight improvement, inquiry and demand for copper have declined again and the market is slightly easier than a week ago.

The tin market is quiet and fairly steady with but little buying.

Lead is scarce and, though buying is light, prices are firm and higher.

No improvement is in evidence in zinc.

IRON AND STEEL

Further moderate contraction in steel operations and slight downward changes in prices have marked the week's events in the steel market. There have been improvements in building undertakings and in automobile demand for steel as well as a better output in sanitary and builders' hardware lines. Cities are also placing more orders for cast-iron pipe. There is evidently no foundation for the many rumors circulated that a change in prices and a reduction of wages is imminent this week by the Steel Corporation, though a few developments point to some decision this month.

Rather vigorous reductions in some prices have been made by a few independents. Plates have been offered at 2c., Chicago, and merchant bars in small lots can be had at 2c., Pittsburgh, while \$2 to \$5 per ton under recent low prices can be done on sheets. Open shading in steel pipe and tin plate has developed in the week.

A 200-ton lot of Chinese pig-iron has been sold to a Pacific Coast melter at about \$35, delivered, competing with Alabama iron, figuring on a basis of \$25, Birmingham.

The March pig-iron statistics of 'The Iron Age' show the greatest shrinkage in output in all the months of the decline. Production today is the smallest on record in proportion to the country's capacity. The March total was 1,595,522 tons for 31 days, or 51,468 tons per day, against 1,937,257 tons in the 28 days of February, or 69,187 tons per day.

COPPER

There was a temporary enlivening of demand immediately after the announcement of further drastic curtailing of production and a consequent firming of prices to 12.75c., delivered, but it has not lasted. During the week sales of small lots were made as high as 13c., inquiry was fairly good, but not all of it by any means resulted in purchases. The course of the market has been slightly downward again until now electrolytic copper is obtainable at a minimum of 12.75c., delivered, or 12.50c., New York, for April and May delivery, with 13 to 13.25c. asked for June. Lake copper is nominally lower at 12.75c., delivered.

TIN

The market has been quiet as to transactions and steady as to price fluctuations the past week. Spot Straits has ranged between 28.25 and 29.25c., New York. Yesterday the quotation, largely nominal, was 28.50c., New York. The tone is fairly firm with inquiry fairly good. Sellers, however, are not many nor are they anxious to press the market, and consumers are not actively interested. On Monday there was a sale on the New York Metal Exchange of 25 tons of March-April shipment at 29c., with other Eastern-shipment sales in small volume reported at around 29c. There were buyers of futures at 28.75c. and sellers at 29 to 29.25c. The London market is lower, possible because of the coal strike. Yesterday spot standard was quoted at £152 10s., future standard at £156 5s., and spot Straits at £160 10s., the two former £9 lower than a week ago and the latter £7 per ton

lower. Deliveries into consumption in March were 1683 tons, with the quantity in stocks and landing on March 31 at 3476 tons. Imports to April 1 were 5443 tons, against 13,650 tons to April 1, 1920. The quantity afloat is returned as 1090 tons, an exceedingly low figure.

LEAD

The feature of this market, especially as compared with others, is the scarcity of lead. As a result the market is strong, but it is quiet because demand is light. On March 31 the American Smelting & Refining Co. again raised its quotation 15 points to 4.25c., both New York and St. Louis, but the outside market has already passed this level. While the market most of the week has been as high as 4.40 to 4.45c., New York, at which levels some small sales were made, it is believed that most of the business is now being done at the price of the leading interest. We therefore quote the market at 4.25c., New York and St. Louis, for early delivery.

ZINC

Absolutely no improvement is discernible in this market, unless the fact that prices have not gone any lower is a good sign. There are a few sales reported of carload and large lots up to 200 tons for early delivery by one or two producers. These sales represent immediate needs of a few consumers. Production is still very small and sellers are not urging buyers nor offering for future delivery. There is a firm belief that prices have reached bottom. Quotations are steady at 4.65c., St. Louis, and 5.15c., New York, for prime Western for early delivery. Galvanizers and brass-makers are buying for hand-to-mouth needs.

ANTIMONY

Wholesale lots for early delivery are quoted at 5.12½c., New York, duty paid, with demand unimportant.

ALUMINUM

The leading interest quotes virgin metal, 98 to 99% pure, in wholesale lots for early delivery, at 28c. f.o.b. producer's plant, with the same grade, largely from foreign sources, obtainable at 23 to 23.50c., New York.

ORES

Tungsten: An improvement is noted because of the elimination of the cheap material recently offered and because of some inquiry from consumers for good quality ore. Sellers are not anxious to part with this material and are waiting, holding quotations firmly at \$3 to \$3.50 per unit in regular 60% concentrate.

Ferro-tungsten, guaranteed and in lump form, is quoted at 58c. per pound of contained tungsten.

Molybdenum: The market is inactive with quotations nominally unchanged at 55 to 60c. per pound of MoS₃ in regular concentrate.

Manganese: There is no demand and offerings are noted as low as 30c. per unit, seaboard, for high-grade foreign ore. Importations in February, the latest data, were 53,874 gross tons, bringing the total for the eight months ended February 28 to 493,968 tons against 132,928 tons for the same period a year ago.

Manganese-Iron Alloys: Demand for ferro-manganese is confined to small lots which are going at \$90, delivered, and filled by American producers. British quotations are unchanged at \$100, seaboard, but this can be competitively shaded. There is but little demand for spiegeleisen, which is quoted at \$32 to \$36, furnace, depending on the sellers. Importations of ferro-manganese in February were 854 tons, against 2939 tons in February 1920. The total for the eight months ended February 28 was 39,952 tons, against 23,420 tons for the same period a year ago.



T. A. RICKARD, Editor

RUMORS of a possible hitch in the appointment of Mr. H. Foster Bain as Director of the U. S. Bureau of Mines had been coming from Washington, so that the announcement of his nomination by the President last Saturday was most welcome to his many friends in California and elsewhere. We take the opportunity of again wishing Mr. Bain the very best of success in his important work.

ZINC, more particularly the profitable exportation of that metal, is the subject of an investigation that Mr. Hoover is reported to have started in his capacity as Secretary of Commerce. Mr. Hoover is particularly well informed concerning the economics of zinc owing to his connection aforesaid with the Zinc Corporation and other zinc-producing enterprises in Australia. We feel sure that he will be able to conduct a useful enquiry.

OF the making of books there is no end, but only a few justify their existence. On another page we publish a review of Mr. Edwin E. Slosson's 'Creative Chemistry'. It is a kind of book for which there is a real demand, for it recounts the achievements of science in the development of industry in a style that is attractive alike to young and old. The popularization of science is rarely achieved without damage either to science or to literature; a book that is scientifically accurate, easily understood, and attractively written is a boon and a blessing to mankind. Mr. Slosson has a charming style, he is rich in apt simile, he has the touch of humor that makes even the grimmest technology radiant, he has a vocabulary so large that he can explain himself vividly, he is rich in facts without being poor in fancy, he does not sacrifice scientific precision to rhetorical effect, he avoids the pitfalls into which most 'popularizers' fall, and he brings to his task a literary skill that few expositors have at their command. Huxley would have rejoiced to read 'Creative Chemistry'. The great protagonist of scientific education would have appreciated keenly the success of this effort to do what he himself did supremely well, the delivery of lay sermons on the principles and applications of the sciences to human industry.

A CIRCULAR has been sent out by the secretary of the Institute, accompanied by a voting card, to inform members that they now have the option of assisting in the prevention of economic waste by voluntarily

restricting their privilege to receive all the bound volumes of the Transactions, that is, they can requisition only those that deal with subjects in which they are interested. This is a step in the right direction. Many members will welcome an opportunity to help in the reduction of the Institute's abnormal publication expenses; but it is to be hoped that the money so saved will not be used in an attempt to sustain the monthly magazine, 'Mining and Metallurgy'. The next step required is to circularize members asking them whether they are willing to reduce expenses by foregoing the privilege, for which they never asked and in connection with which they were never consulted, of receiving the monthly magazine. Indirectly, it cost the Institute a good deal to produce and distribute; last year it involved a serious loss of money. We believe that a questionnaire would elicit the fact that to the majority of members it has little or no value. A monthly bulletin is all that is needed. This should contain, among other essential information, the professional records of those seeking admission, as formerly, and not the mere statement of the position now held and the names of proposers, as is the custom at present.

BONDS to the tune of a million dollars are being placed in San Francisco by the Compagnie Du Boleo, a French company owning the famous copper mine at Santa Rosalia, in Baja California. This Mexican mine has been operated for 35 years and has produced 330,000 tons of copper. The bonds are in the form of 8% serial debentures and should be readily absorbed by the banks and financial houses of San Francisco because the issue is intended to finance purchases of supplies and materials in this city. For obvious reasons, it is highly inadvisable to raise the money in France and then spend it here, the rate of exchange being so adverse to any such transactions. In 1919 the company's income available for dividends was 6,500,000 francs. The new capital is to be used in buying a tank-steamer and in converting the firing of the furnaces from coke to oil, as well as to liquidate the obligations already incurred by the construction of a new smelter. Here we may suggest, in a friendly way, that if the Compagnie Du Boleo had not been so secretive concerning its technical operations, that is, if it had not checked any effort to publish technical data concerning its mining and smelting operations, it would be much better known to our people and could

so much more easily enlist financial interest in its enterprise. When the Anaconda company issued bonds, it found a well-informed and therefore friendly market, because it is so hospitable to visiting engineers and so free at all times with the technical data desired by the profession. We hope that the Compagnie Du Boleo will obtain the money it needs, for it is a sound well-managed enterprise, and we trust that it will also become a little less secretive now that our people have shown themselves willing to assist it financially.

THE address on 'Prospecting' that appears in this issue does not, of course, cover the subject adequately; it merely touches a few of the phases of a vocation and a technique that include men and methods in great diversity. Even a hasty reference to the indexes of back volumes of the 'Mining and Scientific Press' will show that a great deal has been written on the subject of prospectors and prospecting. Most of it was written by engineers, and that gave it a definite value, but we should have been glad to see something from the pen of the prospector himself. Unfortunately he is rarely articulate in print; to him the pick is mightier than the pen. Occasionally a pseudo-pro prospector of fluent speech and verbose writing has broken into our columns, to little useful purpose. All the more therefore should we welcome a genuine message from the real prospector. Perhaps one or two of them will read the address delivered at Portland and will be moved thereby to tell us what they think of the future of their calling, which is one of romantic interest and industrial importance. Say, partner, won't you chip in?

MINERS, millmen, machinists, electricians, and hoisting engineers employed by all but three of the mining companies at Tonopah are on strike in consequence of the recent announcement that wages would be subjected to a uniform reduction of 75 cents per shift. Tonopah has never suffered seriously from the activities of the radical labor agitator, and, though labor troubles have not been unknown, the mining companies and their employees, with the help of a Federal Mediator, have worked harmoniously by means of written or tacit agreements as to wages. The mines of Tonopah produce nothing but gold and silver, so that, thanks to the Pittman Act, the companies are suffering neither from low prices nor from lack of a market for their output. The cost of supplies is decreasing rather than increasing, so that it looks as though the reduction is being made simply to take advantage of the surplus of labor resulting from the shutting-down of the copper mines. Many miners thrown out of employment have doubtless gone to Tonopah, where they know there is work for a limited number. We surmise that this is the real reason behind the cut in wages. The companies assert that the cost of living has decreased 20%; the union men declare that for the man who must pay for board and room, at least, the cost is even higher than it was a year ago, and accuse the mine operators of bad faith. They complain especially that

the decision to decrease wages was made arbitrarily without giving the workers an opportunity to present their side of the case. It seems that the order to strike followed a request on the part of the union men for a reconsideration of the cut. An appeal sent by the employees to Senator Pittman elicited a telegraphic reply in which he is quoted as saying: "In my speech at Tonopah I urged both miners and operators to let well enough alone. I did then, and do now, under all conditions consider reduction of wages an unnecessary and unfortunate matter". The mining companies at Tonopah may be justified in cutting wages at this time, but in our opinion they are making a blunder in taking a dictatorial attitude simply because circumstances give them the opportunity.

Colorado School of Mines

We have received a copy of the Senate Journal of the 23rd General Assembly of the State of Colorado, of April 4, 1921, containing the text of the report of the Legislative Committee appointed to investigate the affairs of the Colorado School of Mines. The Committee finds that "the troubles are of so long standing and are affected by opinions and prejudices so varied and opposite that it makes it difficult to consider the evidence". The present faculty is harmonious, says the Committee, and "is working energetically to maintain a high standard for the School". The student body likewise is commended; it is "composed of an intelligent and energetic body of young men, who give promise of great usefulness to the State and to the world". The Board of Trustees, says the Committee, "did not over-step any propriety in assuming jurisdiction occasionally". As to the dismissal of President Parmelee, the Trustees were within their rights "in view of the fact that they are held in full accountability to the Governor and to the people of the State for the administration of the School". The summary dismissal of teachers by the Trustees is deprecated as "discourteous" and as tending to the "demoralization of the School". In regard to President Alderson, the Committee finds no evidence to sustain the charge that he has lowered the standards of scholarship or exercised improper pressure to induce teachers to support his actions. The Committee even goes so far as specifically to absolve Dr. Alderson of plagiarism in his literary excursions. The report says: "We find insufficient evidence to justify the charge". Does this mean that the evidence although insufficient appears to justify the charge? The members of the Committee seem to us unfit to pass upon a matter of literary etiquette. The President and Trustees of the School were lacking in diplomacy in their treatment of the U. S. Bureau of Mines, which, in consequence, removed its experiment station from the Engineering Building of the School to another State. So says the Committee, which, however, suggests that the change had no connection with the disagreement. Much of the criticism of the experimental mill is unjust, in the opinion of the Committee; and it concludes that the plant is "of great value", but, "in order to make it thoroughly useful it is necessary to be completed". The

italies are in the original; apparently a mill can be of great value before it becomes thoroughly useful. Returning to Dr. Alderson, the report describes him as "the storm centre of criticism of the administration of the School of Mines"; it recognizes the fact that "much of the antagonism to him is shown by the older members of the alumni [meaning presumably 'the older alumni'], who seem to feel that because of his administration, the grade of the school and its value to the mining interests of the State, has greatly deteriorated". The Committee finds that he was President of the School from 1903 to 1913, and that during the four years before he was re-instated the School had three presidents, "and the evidence shows that during that interval matters at the School went from bad to worse". The Trustees "sought long and faithfully to secure a competent man" and "finally decided to ask Dr. Alderson to come back". Since then "the record of the School has shown a steady growth in attendance", and there is "no evidence", says the Committee, "of improper conduct in the administration of affairs". Dr. Alderson's activities in the promotion of the oil-shale industry may have been marked by optimism, but the Committee does not think ill of his efforts, because the oil-shale industry "promises much for the State in the future, and President Alderson or any other pioneer in this matter should have encouragement, and not criticism". As to the Trustees, their management of the School is labeled "highly efficient", but the Committee suggests "a larger representation of the mining industry on the Board". Three mining men, it is suggested, should be placed on the Board of Trustees, and, what is even more significant, "the presence [on the Board] of a citizen of Golden [where the School is situated] seems to be a source of dissatisfaction", which should be remedied. This refers to a particularly undesirable and incompetent trustee, who can well be spared. The Committee comes to the important decision that this and all other State schools should be "controlled by one governing body", and legislation for this purpose is to be devised forthwith. The penultimate paragraph of the report finds the management and administration of the School "efficient"; it labels the trustees, officers, and faculty "competent, well qualified, and trustworthy"; and affirms that the entire institution is "entitled to the support, respect, and encouragement of the citizens of the State". We take the report of this Committee at its face value, and give a summary of its findings as a matter of justice to all concerned.

The Mining of Quicksilver

In this issue we publish an interesting description of the old Almaden quicksilver mine and distillation plants, written by Mr. H. W. Gould, who has just returned from a four months visit to Europe, where he made a thorough inspection of all the large quicksilver mines, that is, virtually every important producer outside the United States. Mr. Gould is well known as the manager, during the period of the War, of the New Idria quicksilver mines in San Benito county, California, the principal source of

domestic quicksilver prior to the middle of 1919, when practically all the mines of this country were shut-down. After his visit to Almaden, Mr. Gould went from Spain to the Monte Amiata mines in Tuscany, where more modern methods and equipment are used, and thence to the famous old Idria property in Carniola, now likewise Italian territory. Carniola originally was part of Austria, and the mines were owned and operated by the Austrian government; however, when the map of Europe was being re-drawn at Paris in 1919, Italy saw that if she could acquire the Idria mines she would have control of two-thirds of the known quicksilver resources of the world. How the Italian statesmen grasped the opportunity is a matter of recent history. Mr. Gould is emphatic in acknowledging the courteous and hospitable treatment accorded him by the managers of mines, as well as by government officials both in Spain and in Italy. The Almaden is one of the great mines of the world; it has produced 5,337,721 flasks of mercury; 23,969 flasks in 1918 alone. The ore in reserve on January 1, 1920, was computed to contain 440,000 flasks of recoverable mercury. Much of the ore contains 25% of the metal; the average content of the mine-output ranges from 8% to 10%. In spite of apparent inefficiency in the organization and in the metallurgic operations, it is not surprising that with high-grade ore and cheap labor it is possible to deliver quicksilver at New York for less than \$30 per flask, before the *ad valorem* duty of 10% is paid, not only from Spain but from Italy, where much the same conditions obtain. Here, obviously, is the reason for the present predicament of the owners of idle quicksilver properties in the United States. Other factors are involved that can be made clear by a brief review of the history of the industry. Production of quicksilver from high-grade cinnabar ores commenced in California about 1850. Later, when stamp-mills using amalgamation sprang up along the Mother Lode, and elsewhere, the quicksilver industry thrived; the average production from 1875 to 1884 being 60,000 flasks per year, mostly from ore containing from 1% to 2% mercury. During the period from 1900 to 1914 the producers received an average of \$43 per flask; there was little incentive to develop new ore and the average tenor of the material treated gradually decreased. Deposits of cinnabar are characteristically spotty and much mine-work is necessary to determine the position of the profitable shoots. Ore-reserves were gradually exhausted and reduction plants were allowed to deteriorate. This was the status in February 1916 when the demand for mercury suddenly sent the price skyward, to \$300 per flask. Later, the producers contracted to sell their entire output to the Navy Department at \$105 per flask, and every effort was directed to maximum production. Old condenser plants were demolished to recover the mercury absorbed by the brickwork; dumps were re-worked; and many of the mines were stripped of every ton of rock from which a profit could be wrung. In their effort to produce at the time when miners were scarce the companies necessarily neglected development; the result was that there was

grave doubt, just before the Armistice, as to whether the requirements for 1919, as indicated by the estimates of the War Industries Board, could have been met. Early in 1919 the Government sold a large part of its excess supply; later, stocks from Europe began to appear in this country, whereupon the price dropped to approximately \$15 on a stagnant market, and the domestic producers could do nothing but discontinue operations. The monthly production in the United States today is probably less than 300 flasks, as compared with an average of 3000 during 1918. What then of the future? These facts must be faced. Quicksilver is indispensable in the event of war; it is essential as a constituent of the fulminate that is used to explode shells, both large and small, and of the antiseptics required in surgery. If an emergency should arise and if importation from Europe should in any way be stopped, the country would be seriously embarrassed in its efforts to obtain the needed supply of mercury either from the ore that is ready to be mined or from the ore that might be immediately developed. Prudence dictates one of two courses: (1) The stimulation of prospecting for, and the developing of, new orebodies, which can be accomplished by establishing a high protective tariff, such as the duty of \$37.50 per flask provided by the bill now being considered. It may be pointed out that the effect on world commerce and finance of a high tariff on mercury would be of little consequence because of the relative smallness of the industry. (2) The purchasing at a low price and the storing of a quantity of quicksilver or its compounds sufficient to supply the maximum possible needs for a period of two years. Deposits are known to exist in California, Nevada, Texas, Oregon, Idaho, and other States that could be made to yield all the mercury that might be needed; it would only be necessary to spend the money required to mine and treat low-grade material; and, of course, time would be required to develop the ore and to build the reduction plants. Some engineers take the view that it is advisable to conserve the present limited known supply; others argue that the wise course is to mine the cinnabar already available, with the expectation that more will be found.

American Industry in the War

One of the most interesting publications prompted by our participation in the World War is a report of the activities of the War Industries Board, by Mr. Bernard M. Baruch, the chairman. This was issued recently from Washington. The success attending the efforts of that organization may be gauged from the fact that no default was recorded of any single demand made by the military establishments. Industry, as soon as the United States entered the War, appreciated the need for co-operation and even for some measure of sacrifice. The response was complete: there were no slackers. When the Armistice supervened so unexpectedly the industrial war activity of the country was reaching a peak of output and co-operative efficiency. Germany realized this; it was one of the main causes for the sudden termination of the War. A

glance at the pages dealing with commodities shows the dominating importance of the mineral industry.

Copper is next to steel in importance as a war metal. The price of electrolytic copper was 16 cents per pound before 1914, and rose steadily to 35.71 cents in March 1917. During 1916, England and France had purchased over 660,000,000 pounds in America. During September 1916, 448,000,000 pounds was bought at 27 cents. It was believed by some that any consideration of price should be secondary to increased production; others, including Mr. Baruch, believed that price control was necessary, in addition to the application of an excess-profit tax. The copper-mining companies were the first to co-operate on a satisfactory basis, and to set an example that was speedily followed by others. An immense delivery was guaranteed early in 1917 at about 16½ cents, for American army and navy needs. The story of the fixing of prices, of the agreements and disagreements between the industry and the Board, is told. On September 21, 1917, the price was fixed at 23½ cents, and remained thus until July 2, 1918, when it was increased to 26 cents, remaining at the last-mentioned figure until the end of control. Difficulties were encountered; war requirements amounted to over 90% of production; domestic uses were curtailed by the Board's action in purchasing a large proportion of the output and by distributing this direct to the munition manufacturers. During the War there was a 100% increase in the production of recovered copper, the 1918 output of such metal being 500,000,000 pounds.

With zinc, as with copper, the American government demanded and obtained a considerable reduction from the current market price. Owing to shortage of other metals it was found practicable in many cases to substitute zinc for tin, aluminum, lead, and nickel. Zinc castings even took the place of brass castings. As with copper, the Allies had to pay through the nose before this country entered the War. Prices rose from 5.08 cents in November 1914 to 22.5 cents in June 1915, an increase of 350%. Over-production then brought about a readjustment, the price falling to 21 cents in March 1916. On February 13, 1918, the maximum price of 12 cents per pound, f.o.b. East St. Louis, was set for Grade A zinc.

The demand for manganese in the expanding steel industry resulted in a shortage. Efforts were made to stimulate production and to increase importations from Brazil; increased local yield was brought about by a guarantee to the producers, about the middle of 1918, of \$1 per unit over a period of twelve months; importation was hampered by shipping needs in other directions. We learn that the 'Cyclops', which mysteriously disappeared, was on her way to this country with a cargo of manganese ore. The shortage of vanadium reminds us of the fact that, at the present time, one country, Peru, and one company, the American Vanadium Company, practically monopolize the industry. Demand exceeded supply at all times during the War. Mr. Baruch mentions that the question of supply should warrant the attention of the Government in peace times, as a measure of prepared-

ness for war. Tungsten was another metal in connection with which the rise of price was spectacular. In January 1913, \$7.50 per unit was paid; in April 1916, it cost \$80 per unit. The use of tungsten in the composition of cutting steels increased the demand during the time when American firms had large contracts for shells and guns from the Allies. It was then found that a weld could be made of ordinary steel and tungsten-steel, so that the special alloy need only be used for the cutting edge. Prices dropped in harmony with the decreased demand and remained around \$25 per unit from the middle of 1917 till the end of the War. Chromite was equally essential, but the United States produced only a very small amount: 591 tons in 1914. Domestic production was encouraged and was increased to 60,000 tons (50% chromic oxide content) in 1918. The United States produces 10% of the world's tin supply and uses more than 50%. The deficit was made up by largely increased imports from Bolivia; tin and tin products were practically excluded from export during the War. A so-called Tin Executive was formed in London, with representatives of the United States, Great Britain, France, and Italy. Its activities were largely in connection with the purchase and allocation of tin to the various countries on an equitable basis. The production of aluminum in the United States is a monopoly of one firm, the American Aluminum Company. The attitude of this concern toward the Government was eminently fair: there was no shortage. Lead rose in price on July 1, 1917, to 11.17 cents per pound—160% above pre-War prices, due to European demand and irregular buying. On June 18, 1917, the Government secured a contract for 83,000 tons at 8 cents. The industry was warned to keep prices down below excessive levels, or price-fixing would be resorted to. Market cost only fluctuated to a slight degree till the end of the War. The production of sheet-lead had increased from 15,000 tons in 1914 to 33,000 tons in 1918.

With nickel, the shortage was met by a radical curtailment of non-essential consumption. There was no price-fixing. The International Nickel Company, of Canada, which controls a large proportion of the world's production of the metal, arranged to supply our government with all it needed at 20% below market quotations, and slightly lower than the pre-War average. Prices remained steady throughout the war period. Quicksilver was a metal the price of which fluctuated wildly, being sold in 1916 at eight times the peace average; the Government paid about three times the pre-War normal. There was no shortage; little control was necessary. Antimony comes, for the most part, from China; prices rose from a pre-War normal of about 6.36 cents to 34.66 cents in April 1917; there was no shortage at any time. From July 1917, the price declined; demands were small.

The 'Story of the Nitrate Problem' forms an interesting appendix to the volume. In 1913 we imported 625,000 tons of Chilean saltpetre. In 1916, Allied orders with American munition plants had increased the amount to 1,218,423 tons. Both for America and for the Allies, Chilean nitrate was practically the only source, during

the whole of the war period, for the nitric acid that is an essential for the manufacture of all powders and explosives. We started three fixation plants, but none was completed before the Armistice. By April 1917 the pre-War price of the Chilean product of 2½ cents per pound had been increased to 7½ cents. The national gold reserve of Chile was in Berlin; Germany before the War had been absorbing about one-third of the total output of nitrate. Our Naval Intelligence Division learned of negotiations between the Chilean and German governments regarding the disposition of the reserve, which ended in a refusal on the part of the Germans to part with the gold. The United States then offered to restore the Chilean reserve, provided that Chile would seize the German-owned nitrate and would sell it to us at about 60% of the current market price. The deal was consummated in the summer of 1917. Prices at that time were beginning to soar; the action of speculators was discouraged by an agreement with the Allies whereby purchasing was curtailed for three months. Great Britain waived its regulations, allowed jute sacks to be shipped from India, and permitted English ships and docks to handle the German-owned nitrate. The deal caused consternation among the speculators, the market was stabilized, the Allies supported "the demand market" and covered requirements at a price about 60% below current prices of the previous summer. This effective co-operation permitted the United States government to make good on the price of 4½ cents per pound, fixed in April 1917 when the market price was from 7 to 7½ cents. The total nitrate cost to our government during the whole of the war period was only 4½ cents per pound. The success attending these negotiations with Chile and the Allies was the result of eight months of continuous effort and diplomacy under difficult and trying conditions; it reflects credit to all concerned.

The Treaty With Colombia

Mining engineers during recent years have been called upon to take an increasing interest in national and international affairs; it has been realized that support for, or complaint against, the administration at Washington has no moral standing if it is not the result of thoughtful public opinion. It is imperative therefore that we know the facts about great issues; we should be able to come to a clean-cut and convincing decision based on deduction rather than on hearsay. President Harding is confronted with a number of problems of no mean importance; among them is the question of the payment of a sum of \$25,000,000 to the republic of Colombia, because the Panama Canal Zone passes through territory that once belonged to that country. The history of the dispute is of comparatively recent date. In June 1902 President Roosevelt signed a bill by which the Panama route was chosen for an inter-oceanic canal. Negotiations took place between the representatives of the French canal company and the United States government for the fixing of a sum to be paid in return for the work already done, and to secure the rights under the

concessions granted by Colombia. The French suggested \$100,000,000; the United States offered \$40,000,000, which was agreed upon. In the meantime a treaty was signed between the representatives of the governments of the United States and Colombia, by which a strip of territory on each side of and including the proposed canal, was to be granted to the United States; provision was made for proper protection; and the United States agreed to pay a lump sum of \$6,000,000 for the concession, as well as an annual rental of \$250,000. Colombia then hesitated, and refused to ratify; this showed a considerable amount of cunning, it being argued, doubtless, that in a few years (1904) the concession granted to the French company would lapse, and the latter would then automatically relinquish claim to all salable rights in that part of Central America. Colombia would then collect the \$40,000,000 promised to the canal company by the United States, in addition to the other agreed sums. A new treaty was drawn up, but Colombia procrastinated still further, and made fresh demands, obviously for the purpose of gaining time. Further negotiations resulted, until only a month or so was left before the lapse of the concession to the French. In the meantime, the province of Panama began to realize that whatever money passed hands, as a result of the acquisition of lands and rights by the United States, would go to the Colombian government and to the Colombian capital. Revolutionary forces became active; there was a strong feeling in favor of separation and a resumption of Panamanian independence, for the ties with Colombia were of a political nature only. On November 3, 1903, Colombian troops arrived at Colon, on the way to Panama, to quell the insurrection. But the United States had an old treaty, by which it could oppose, by force if necessary, any interference with railway traffic across the Isthmus. So the Colombian soldiers were refused passage, their officers were placed under arrest, a certain amount of judicious bribery prevented bloodshed that might arise as a result of an opposition to the inevitable; and the Republic of Panama again came into being without the loss of a single life. Criticism has been leveled against the United States for the part played in assisting in the establishment of the new republic, but the following facts are obvious: Panama was previously independent, and wished to regain that independence; Colombia, with an eye for American dollars, had procrastinated to such an extent that continued diplomatic negotiations were impossible, and action became necessary; the interests of civilization, the reduction of economic waste, and the safety of the United States, dictated a policy of unofficial interference; and events have proved that the building and operation of the Canal would have justified an attitude considerably more drastic than was actually taken. The republic of Panama was immediately recognized by the United States, Great Britain, and all the other great powers. The seal of approval of the world was thus placed on this country's action in the matter; Colombia automatically forfeited all further interest in the Canal Zone. Negotiations were opened with the new government, an agreement was

speedily reached. Panama was paid \$10,000,000, and an annuity was agreed upon in return for the territory that was acquired afterward by the United States.

Colombia was badly beaten in the game of international diplomacy. She had missed an excellent opportunity, she had procrastinated to an exasperating extent, and she had exhibited unparalleled greed in her attitude both toward the French canal company and toward the United States government. She overlooked the fact that we had trump cards, which, thanks to the masterful man and brilliant administrator then at Washington, were played at the crucial moment. Colombia's chagrin was evident; it has since accumulated at compound interest and in direct proportion to the encouragement received from the anti-Roosevelt party in this country. She now claims the sum of \$25,000,000 to salve her wounded feelings and to make good the material loss of territory. It is unfortunate that the issue has become a political one and also that the pro-ratification party is strong enough and bitter enough to make it a personal question. The arguments in favor of national submission and the payment of the blackmail are as specious as they are absurd. We are told that business expansion in Latin America is being held back because of our disregard of the principles of justice. This is a stupid assertion; no Latin-American nation would side actively against us on this question; none are above accepting a gift, but few would persist in such a demand as is being made by Colombia at the present time. Full justice has been done to all concerned; Colombia received her deserts in 1903. It is said that we owe Colombia money for what we seized. This, too, is wrong; we paid for the territory acquired at a time when, by recognizing the government of Panama, we proclaimed, as did other great nations, that Colombia had no further rights on the Isthmus. The facts must be faced. If we yield to the demands of Colombia and pay over this huge amount, we are acknowledging that we pilfered the Canal Zone. What impression on our Latin-American neighbors and friends would result from this tacit admission of wrong-doing? To do so would be to admit that we have neither moral nor legal right in Central America; our government would be placed in the humiliating position of the schoolboy who admitted that he stole the widow's apples and agreed to make good the theft. In addition to a serious loss of national prestige, such action might involve endless extortion.

The Panama canal was a costly venture for the people of the United States; its maintenance involves a considerable expense; all obligations were paid promptly and in full. The Colombian demand should be resisted, once and for all. We cannot buy goodwill with American dollars; to attempt to do so would be to lower ourselves in the estimation of the world. Negotiations in connection with American interest in Colombian oil-reserves would doubtless be facilitated if the \$25,000,000 were paid; American expansion in any other country of the world could be secured by similar means. But a course must be found that will not involve a loss of national prestige, national pride, and national honor.

The Black Range Tin District of New Mexico

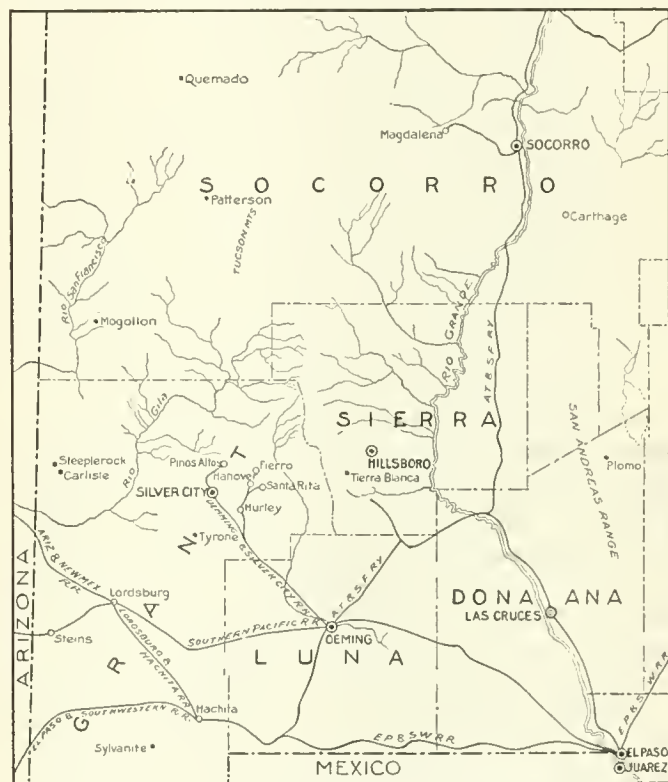
By Foster S. Naething

In the early history of New Mexico, the North Star trail was the main artery of travel from Santa Fe south-westward. The road was passed over by many a hardy pioneer in search of gold and undoubtedly all of the country tributary to the road was well prospected. From Magdalena south to Silver City, little mineral was found, and with the building of the Santa Fe and Southern Pacific railroads the old trail was abandoned. For thirty years the western slope of the Black range of New Mexico, which is cut by this trail, was virtually uninhabited and became famous as the best hunting ground in the South-West; but in 1919 C. M. Welch, a prospector of the old school, wandered into the region and found some heavy brown nuggets in his pan when he was prospecting for gold on Taylor creek. Everyone to whom he showed the nuggets laughed; told him they were iron and that he was a fool to waste his time panning for more. Welch was not satisfied, as he thought the strange-looking nuggets too heavy to be any common mineral, and in the spring of 1919 he sent an ore-sack full of them to be assayed in Denver. No gold or silver was found, but the entire sack assayed about 30% tin.

A party was immediately organized in Denver and rushed to New Mexico to find the source of the tin. They were in such a hurry that when they arrived late in the evening at Grogan's ranch, which is about eight miles from where Welch was camping, they could not wait, but paid Grogan \$100 to take them through that night. Upon their arrival at Welch's camp, he refused to show them where he had found the nuggets, and although they could not have taken a pan of gravel from any of the side gulches, near his camp, without getting a little tin in their pannings, they apparently failed to recognize the tin and left after two days completely disgusted with the district, and reported to everyone that the tin discovery was a fake. Welch, however, was soon joined by other prospectors who made their headquarters in some caves on Taylor creek, and they, with true prospector's optimism, called the place Cave City. These caves apparently at times were inhabited by the cliff-dwellers of the Gila, as some of their broken pottery, and at one place the ruins of a wall, were found. Extensive prospecting was now started and Taylor creek was located for its entire length of about twenty miles.

In the fall of 1919 Frank P. Davis began prospecting the country north of Cave City and discovered placer tin in Squaw creek. In the spring of 1920, Davis and Alec McDonald found a rich placer five miles north of Squaw creek in Castle Rock creek; also a small side gulch, which they called Nugget gulch. During 1920 considerable prospecting was done and much progress was made in working out and tracing the tin mineralization.

The prospectors were greatly hindered by the fact that none of them at first recognized the different minerals and that they did not understand how the tin occurred. However, in all fairness to them, it should be related that I showed a particularly rich nugget from this district to at least twenty members of the American Institute of Mining and Metallurgical Engineers, one of whom was a State Geologist, and none of them even suggested



(The tin district is at the north-west corner of Sierra county)

that the nugget might contain tin. Later it was assayed and it ran 67% tin.

The oldest rock in the district is a rhyolite-porphry, which contains the tin. It is of Tertiary age and of unknown thickness, although it has been cut by Taylor creek to a depth of 600 ft. The porphyry apparently was eroded to approximately the present relief in Tertiary times and the valleys filled by a flow of rhyolite, which picked up and cemented together gravel and boulders of the older porphyry. Along Beaver creek there are several contacts of rhyolite-porphry and basalt; these show that the basalt is the younger rock. Near the summit of the Black range there is a contact between the rhyolite-porphry and andesite, the andesite apparently being a flow later than the porphyry.

The tin has been found both in placers and in place. It occurs entirely as cassiterite, which usually is intimately crystallized with hematite and magnetite and in

places occurs with a little quartz, although the quartz is generally lacking. Not a trace of sulphides has been found in the district. The cassiterite and iron minerals occur in small irregular veins and seams that apparently were caused by the cooling of the rhyolite-porphyry and were the lines of escape for rising solutions and emanations. The average vein is little larger than a knife-blade, a width of one inch being the exception. On Squaw creek, bunches of ore were found six inches wide that would assay 30% in tin. The porphyry has been altered on each side of the veins, and part of the feldspar replaced with the iron minerals and in places with the cassiterite. There does not seem to be any definite relation between the percentages of iron and tin in the ore, as on Taylor creek most of the veins are high in iron and low in tin, while on Nugget gulch most of the veins will carry over 50% tin. The mineralization seems to be concentrated in certain areas, probably where the fracturing of the cooling porphyry has been particularly extensive. Some of the cassiterite occurs in the form of brilliant red crystals, which are particularly noticeable in the workings on Squaw creek. Tin has been found in a large part of the area from Nugget gulch south to Hoyt creek, and from Beaver creek east to the headwaters of Squaw and Taylor creeks. In this area I have taken several hundred samples of gravel and in every case found at least a trace of tin in the black-sand pannings. The area totals approximately 200 square miles.

The best showings of tin in place have been found on Squaw creek, Nugget gulch, and Taylor creek. On Squaw creek two tunnels have been driven, and what seems to be the intersection of two crossing systems of fractures was cut by the upper one, which is 55 ft. long. For 37 ft. the entire tonnage from this tunnel assayed from 1 to $1\frac{1}{2}$ % tin. About eight definite veins were cut, but they were very small and extremely irregular, the tin occurring partly in bunches. The other tunnel, 125 ft. long, driven a little to one side and about 30 ft. below the upper tunnel, showed only traces of tin. The replacement of the porphyry by the iron and tin minerals is very conspicuous in the upper tunnel.

In the Nugget Gulch area many open-cuts have been dug, and although tin was found in almost every one of them, no regular veins of any size were found. An area about 1000 ft. long, by several hundred feet wide, is cut by a great number of seams and the entire mass of the porphyry in this area probably carries about 0.1% tin.

On Taylor creek near Cave City some veinlets have been followed by trenches, and at the present time a company is driving a tunnel from the level of Taylor creek in order to cut the deposit at a depth of about 500 feet.

The development so far has shown that the tin is widely distributed, but that it occurs in extremely irregular veins and seams.

Most of the rhyolite-porphyry has been covered by other rocks until comparatively recently, and as the rainfall is light, the tin has been but little concentrated in placers. As an example of this, I sampled the gravel in over thirty places on Indian creek and although traces

of tin were found in every case, nothing more than a trace was detected anywhere.

Three placer areas that have enough tin in them to be of some promise are Taylor creek, Squaw creek, and the Castle Rock Nugget Gulch area. Of these, Squaw creek alone has been at all thoroughly tested. Here it was found that while all of the gravel carried a few tenths of one per cent of tin, only in a comparatively narrow channel from 25 to 50 ft. wide and from three to ten feet deep was the tin concentrated. An average of 16 pits dug to bedrock showed that this narrow channel carried between one and one and one-half pounds of tin per cubic yard. The best gravel was in the 12 inches just above bedrock.

Castle Rock creek and Nugget gulch have only been superficially prospected, but nuggets of sensational size were found in Nugget gulch. The largest, consisting of a number of small nuggets cemented together, weighed 37 lb. This piece has not been assayed, but similar nuggets from the same place assayed 50 to 70% tin. As far as I know, this is the largest piece of high-grade tin ore ever found in a placer in the United States.

In Taylor creek the gravel is deep and the underflow of water strong, and although several holes have been put down to water-level, no holes have reached bedrock, and just how much tin the gravel in Taylor creek carries has not been determined.

The district is so large and has been prospected to such a limited extent that the possibilities are still uncertain. It offers a new field for the prospector in a country that is delightful during most of the year.

OPENCAST MINING of beds of limestone, lying practically horizontal, and varying in thickness from 7 to 15 ft., is the only type of mining that deserves consideration in Great Britain today, according to Professor Henry Louis, who contributes to the current bulletin of the Institution of Mining and Metallurgy. The method is carried on extensively in Lincolnshire, Oxfordshire, and Northamptonshire. In 1919 the quantity of ironstone of Secondary Age obtained by opencast working was over 5,000,000 tons as against about 4,000,000 tons of similar ironstone obtained by underground mining. The determining factors in this work are, first, the character, and, secondly, the depth of the overburden. It might be impossible to carry on economical underground mining even below a considerable depth of cover consisting of soft sandy shales which would make an unsatisfactory roof, whereas the presence of a comparatively shallow cover of hard limestone might justify this method in preference to opencast work. It may be stated that opencast work is, as a rule, adopted where the depth of overburden does not greatly exceed 60 ft., but it is impossible to determine any precise depth at which a line between these two methods can be drawn, unless the nature of the overburden is also considered. In Northamptonshire opencast working is feasible with as much as 60 ft. of overburden, so that the removal of 6 cu. yd. of overburden is necessary for the extraction of 1 cu. yd. of ore.

Prospecting, Past and Future

By T. A. Rickard

¹The god of prospecting is Billiken, the imp of good luck. He has a knowing smile, as if the contentions of the learned were a joke to him and as if the trappings of science were a costume out of date. He himself wears none, only the smile of happy days. I choose him from among the ikons and fetishes cherished by a mystical humanity because, as you know, the discovery of mines has ever been associated with the accidental in human affairs, from that prehistoric morning when a Syrian shepherd on the banks of the Pactolus found a golden pebble on the river's edge, and thereby made Croesus a synonym for wealth, to that late afternoon when an American soldier strolling on the beach of Bering Sea stopped to wash a panful of sand and started the second rush to Nome.

May I quote two or three other incidents equally fortuitous and famous? An Australian miner in Queensland stoops to pick a wild orchid, to send to his sweetheart, and finds it rooted beside an outcrop of quartz speckled with gold. Thus a famous mine is born. Another Australian digger, at Ballarat, disappointed by failure, decides to rest under the shade of a tree, but before lying down he strikes his pick impatiently into the ground, whereupon it sticks in something soft just under the turf; it is the Welcome nugget, which weighed 184 pounds and was worth \$42,000. Two men grubstaked by a storekeeper leave Leadville on a prospecting expedition. Among their supplies is a jug of whisky, which is awkward to carry, so they dispose of it in the most obvious way while yet on the outskirts of the camp, after which they decide that the spot on which they have halted is as good as any other for sinking a prospect-hole. At a depth of 25 ft. they cut into the famous orebody of the Little Pittsburg mine, and at the only place where the ore comes so near the surface. A carpenter decides to deepen the tail-race of a saw-mill by scouring it with the stream all night long. In the morning he finds several nuggets that have been washed out of the gravel. Thus Marshall discovers the gold of California.

Stories of this kind could be multiplied, but it is not necessary to do so in order to emphasize the haphazard character of mineral exploration in the past, and it does injustice to many of the pioneers of mining, the prospectors and explorers who have opened the wilderness to human industry. Moreover, this phase of prospecting is becoming less prominent as the exposed treasures of the earth's crust are picked up by the unsophisticated, and although good luck will always be an element in the search for the hidden ore, it will cease gradually to be a

major factor, giving place to a steadily increasing measure of scientific method. One is prone to dwell upon the famous deposits that were found by accident, but many were not; moreover, most of the less known, but handsomely profitable, mines resulted from intelligent search. The lucky find makes a tale to tickle the ears of the groundlings, for the child in man loves to hear of the beggar maid that became a princess and of the carpenter that became a millionaire; it seems to redress the inequalities of life and give the under dog a chance. As a matter of fact the finding is usually the result of seeking; the hunter, not the loafer, tracks the quarry; the mariner, not the passenger, brings the ship to port.

The simple story of an accident needs no explanation; the true story of intelligent prospecting requires considerable knowledge of geology and mineralogy, it is much less easy to tell to the uninitiated, and takes longer in the telling. One can recite in a few words how a simpleton stubbed his toe against a piece of golden quartz, but it takes many words, and they must be well chosen, to explain what evidence led James S. Douglas to sink a deep shaft on the United Verde Extension and to persist in his search after the first disappointment. Indeed, the story cannot be appreciated by those unversed in geology, more particularly the structural geology of such a locality as Jerome, Arizona. Most of you know the story of the U. V. X., so I shall not repeat it. Some of you have heard or read how several productive mines were opened up on the Suan Concession in Korea by British and American mining engineers in direct consequence of scientific search.² This concession at one time belonged to the Japanese, who thought it of no value for mining. Subsequently a British syndicate set to work, but likewise soon ceased to prospect, whereupon two Americans, H. H. Collbran and H. R. Bostwick, took hold of the enterprise. That was in 1907. A mass of granite extrudes through sedimentary rocks, chiefly schist and limestone. The periphery of the contact is roughly oval in plan and is 23 miles by 6 miles in its main dimensions. This contact was traced carefully and mapped accurately. The occurrence of ore was found to be associated with dikes of aplite (a quartzose type of granite) and not with the later dikes of basic rock, such as basalt and dolerite. The granitic intrusion had faulted the limestone, thereby creating channels for the circulation of mineralizing solutions, which were stimulated into chemical activity by the heat emanating from the dikes of aplite. The schist contains no ore, and the limestone only where the contact is crossed by faults. The ore de-

¹An address delivered before the International Mining Convention at Portland, Oregon, on April 8, 1921.

²Technical Operations on the Suan Concession, Korea, II'. By A. R. Weigall and J. F. Mitchell-Roberts. 'M. & S. P.', Oct. 25, 1919.

posits near the contact carry copper and gold; those farther away, lead and zinc. Two rich mines, the Holkol and the Tul Mi Chung, have been developed on opposite sides of the elliptical contact; other discoveries have been made, of less importance, but they also constitute proof of the intelligence shown in the search for ore. Several geologists were employed to guide the prospecting operations, which consisted in the first instance of systematic panning, both of the lodes in the native workings and of the detritus in the creeks. If the signs were favorable, that is, if gold, ore-minerals, or contact-minerals were detected, then holes were sunk 300 ft. apart to bedrock, to be followed by intermediate holes, accompanied always by detailed recording and mapping. Then special areas were selected for closer examination, prospect-holes and trenches being dug and everything panned carefully. The average area covered by one white man in an intensive campaign of panning was about four square miles in six months. His assistants were natives. It is interesting to note that D. F. Higgins, on whose advice the prospecting was planned, specified sundry criteria, as follows:

1. Leached, oxidized, rusty-looking, and copper-stained outcrops.
2. Placers at or below the contact.
3. Old workings.
4. Contact-minerals, such as tourmaline, diopside, and garnet.
5. Faulted or sheared zones in the rock adjacent to the contact.
6. Differentiation in the magma as shown by the presence at the contact of small bodies of igneous rock related to the granite.

By noting such evidences and by correlating them, it was possible to search intelligently and successfully. In short, the work done on the Suan Concession is an example of scientific prospecting. Another is the great copper mine at Chuquicamata, in Chile. But that is another story.

The first step in prospecting is to seek for signs and follow them so far as they go. Thus the seeker after ore looks for 'float', the bits of mineral or vein-matter that have been broken, by frost or other agencies of erosion, from an outcrop, which is the part of a lode that protrudes above the surface; or perhaps he follows traces of insoluble metals, such as gold, or insoluble minerals, such as tinstone, among the products of erosion, either in the wash of the creek or in the soil on the hillside. He hunts for these hopeful fragments first in the gullies and valleys to which the rain, the rivulet, and the river are likely to have brought them. He follows them up-stream so far as they continue; then he traces their migration up the adjoining hill-slope until at last he can find no more, a circumstance indicating that he has gone beyond their source. As he looks about him, haply he may find the outcrop from which they came; if not, he digs; he makes a trench across the line of movement of these promising bits of mineral or rock.

We call that 'costeaning', an old Cornish term, from *cothas*, dropped, and *stea*n, tin.

In the Cripple Creek district, of Colorado, there was only one conspicuous outcrop, yet it remained unmarked and unsampled for a year and a half after the first locations had been made, because it consisted not of quartz, but of granite. W. S. Stratton found it by panning the soil and debris on the hillside, thereby tracing the gold up to this granitic comb, which he had disregarded because it was not the white quartz with which he had become familiar in the only other district, Silverton, in which he had mined previously. When his pannings failed to show specks of gold, he knew he had passed their place of origin; at a loss, he broke a piece off the outcrop. It assayed 19 oz. of gold per ton! That happened to be the only important outcrop in the district, as I have stated. Cripple Creek is 10,000 ft. above sea-level; at such high altitudes the rock is shattered by the contraction and expansion due to frost and thaw, so that the true surface is covered by a layer, several feet thick, of fragmental stone on which grow the moss and grass. The hills of Cripple Creek are unprotected by trees or brush, and that is why they served, especially on their sunny slopes, as a cattle range for many years before the miner intruded. The prospector had to penetrate beneath the covering of debris, or 'slide-rock', to find the tops of the orebodies. Two or three years after the district had become prominent the hillsides were so pitted with prospect-holes that they looked as if they were suffering from a geologic rash. Most of the holes were blanks, but others led directly or indirectly to the finding of rich ore.

In many mining regions the soil spreads its mantle over the surface and hides the geologic surface. For example, the important zinc deposits of Oklahoma are in a prairie country formerly valuable only for its annual crop of wild hay. It was an Indian reservation, dotted with small areas of cultivation and as unlike a mining country as could be imagined. Yet at depths ranging from 90 to 200 ft. there has been found a remarkable series of orebodies rich in zinc and lead. These were discovered when drilling for water.

Rich ore may exist underground without giving a sign at surface, and in such case it would remain undiscovered if the exposure of the rock in a neighboring gully or ravine, or some other indirect evidence, were not forthcoming. Near Oroville, in California, the miner erected his derrick and operated his drilling machine amid the tender blossoms of the peach orchards, penetrating at a depth of a few feet into the alluvium from which he won much gold. The dredges destroyed the orchards and left a wilderness of gravel in their wake. These operations were instigated by the knowledge obtained from the sandbars of the Feather river, a mile or more distant, where first the placer miners had found gold fifty years earlier.

Thus soil and frost-broken debris will mask the object of the miner's search. In the colder regions of the North this debris is frozen hard during the greater part of the

year. A cover of moss and ice hides the rock in place. The miner has to await the summer, for mining in ice is impracticable unless aided by artificial thawing, by means of wood-fires or steam. To strip the surface and lay bare the veins in the rock, it has been found practicable in Ontario to use jets of water under pressure. This method of hydraulicking was employed with conspicuous success on the Nipissing claims, at Cobalt, in 1912. During the summer of that year, 33 acres of ground were cleared to a depth of $4\frac{3}{4}$ ft. at a cost of about \$600 per acre. Two years later $95\frac{1}{2}$ acres were cleared in the same way at a cost of \$500 per acre. These operations led to the exposure of a number of rich veins, one of them yielding 27,000 ounces of silver in a shallow open-cut.

Another famous district in which outcrops were lacking was Kalgoorlie, in Western Australia. In this hot and arid region the rock surface is covered with a mantle of wind-blown dust and sand from which gold was won in the early days by means of 'dry-blowing', a method of sifting aided by the wind that plays only too freely over this desert country. Underneath is a compacted layer of sand and clay, called 'cement', so hard as to serve as a false bedrock for the goldbearing debris exploited by the 'dry-blowers', and more than sufficient to hide the veins in the true rock underneath. The rich lodes of Kalgoorlie are softer than the schist they traverse: they contain comparatively little quartz but a good deal of calcite, and therefore weather easily, so that they make no appearance at the surface of today. These famous gold-telluride veins were found by accident. Patrick Hannan was the first to find gold in the cement, in 1893. In the course of the 'dry-blowing' operations of Hannan, and others, an outcrop of barren quartz was uncovered. This sufficed for the flotation of a company, but it was not until later, when digging a trench, that a rich soft goldbearing lode was found, three feet under the cement, thereby changing a sinister wild-cat into a domesticated mining venture, the now celebrated Great Boulder Proprietary mine, which has produced \$60,000,000.

The cover under which Nature hides her metallic treasure is pierced by the prospector, as we have seen. In some instances his work has been anticipated by the burrowing of animals, to which he becomes indebted for valuable hints. The digging done by ants, gophers, and other little miners all over the world has led to the discovery of much ore. Of necessity they must burrow in soft ground, and the decomposed parts of veins or lodes are suitable for their purpose. Herodotus, the father of history, and of many preposterous yarns, tells us³ about a sandy desert in a remote corner of Bactria, now Tibet, to which Indians were sent on camels to bring back the gold thrown up by the burrowing of ants "which are smaller than dogs but larger than foxes". Someday the modern prospector may find this interesting locality, and if he does he ought to be rewarded with nuggets smaller than pumpkins but larger than cherries. Stories less apocryphal come from Rhodesia, where the gold de-

tected in ant-heaps of a normal kind has led to the finding of profitable ore. In Nevada the ground-squirrel has assisted the prospector. The Comstock lode was discovered by inexperienced placer-miners who panned the dirt that had been thrown by a ground-squirrel from a hole in the outcrop. Near Hawthorne a miner noticed a row of white heaps made by these rodents. He had sense enough to pan the dirt, which showed free gold and assayed \$100 per ton. This ore came from a contact of quartzite and limestone, along which the quartzite had been disintegrated and enriched by goldbearing solutions. The site of this discovery became a productive mine and was named the 'La Panta', because the prospector had crossed the Atlantic on a ship named the 'Lepanto', a fact that goes to show that his powers of observation were ahead of his spelling. Anybody can learn to spell; not everybody can be taught to be observant. As Dogberry puts it: "To be a well-favored man is the gift of fortune; but to read and write comes by nature."

Another clue has been furnished by the workings of the human ants of a bygone day. The gopherings of the ancients have opened a way to the discovery of some of our greatest mines. Abandoned diggings incited the development of the Kolar goldfield of India, where ancient workers reached a depth of 300 ft., and where modern miners have gone down since to a depth of over 5000 ft. In the Shan States the slag-dumps of the Chinese led to the discovery of the old workings of the celebrated Bawdwin mine of the Burma Corporation. In Cyprus an American syndicate, attracted by tradition and the mounds of a prehistoric period, uncovered slag-heaps and mine-dumps leading to Phoenician workings in a large deposit of copper ore. In Egypt, Siberia, Mexico, Peru, and other regions, similar pioneer work, hidden in the jungle or covered by the turf, has led to the disclosure of great riches within the last fifty years. The nearest analogue in our own country is the Spanish workings of Santa Rita, which started the development of the Chino copper mine, in New Mexico. This deposit was shown by the Indians to the Spaniards, from Mexico, in the 18th century, when the region was part of Chihuahua. Mining was commenced in 1804. The Spaniards called these mines *Criadera del Cobre*, the place where copper was created.

Among ancient workings recently found and investigated I must refer to those of the Sinai peninsula, to which the Israelites fled on their migration from Egypt. In this arid region overlooking the Red Sea there have been found abandoned workings resulting from the search for turquoise, not copper as was formerly supposed. Inscriptions show the first miners to have been Egyptians, whose word for turquoise was *mafkat*. They made excavations of the room-and-pillar type in the sandstone; and, what is much more remarkable, on the smooth natural face of the sandstone cliffs they cut figures in relief, with writings, which were deciphered by Flinders Petrie, the famous Egyptologist, and by him shown to be 'scenes' in the story of a mining adventure conducted during the reign of Sanekht, the seventh king of

³Book III, pp. 98-106.

the Third Dynasty, about 4950 B.C. On smaller memorial stones, known as 'steles', set upright in the ground, are written the records of successive mining expeditions. One inscription records the arrival of 734 men, indicating the large numbers that were employed. The Egyptians brought all their supplies of food, and water, on trains of 500 asses, or 'burros', as we call them, across the desert from the shore of the Red Sea. Inscribed on the slabs of stone are the names of the staff, and it appears that among the technical men several classes were recognized: one of them was the 'diviner of minerals', or he who looks out for minerals, the prospector, the Egyptian term being *mes en aati*. That he held an important position is shown by the fact that only two were employed on each of four expeditions in which from 300 to 450 men were engaged. Prospectors of the North-West, Canadian and American, I salute you in Egyptian written on rock 7000 years ago: *mes en aati*!

Silver occurs commonly in ore deposits as a sulphide, such as argentite and stephanite. These sulphides are changed to sulphate by oxidation near the surface, that is, within the range of the ground-water, which contains free oxygen. If salt comes in contact with silver sulphate, silver chloride is formed. In the arid region between the Rocky Mountains and the Sierra Nevada, the surficial waters contain salt, which, reacting with silver sulphate, forms the relatively insoluble chloride, a waxy mineral known to miners as hornsilver. That is why prospectors in the South-West are called 'chloriders'. Too much salt in the drainage will cause the silver chloride to pass into solution, and that may be why veins rich in hornsilver, or cerargyrite, the equivalent in Greek, are at their best a few feet below the surface.

The surficial indications of ore are as varied as the minerals that comprise such deposits. The seeker after gold and silver looks for outcrops of quartz, because quartz is usually, but by no means always, the matrix of the precious metals. If the quartz be iron-stained, that is a good sign, for the reason that minerals containing iron, notably pyrite and chalcopyrite, are commonly associated with gold and silver; indeed, iron in an oxidized form is a characteristic indication of the outcrops of most veins and lodes, so much so that a gossan, as the Cornishman terms it, is regarded as a likely cap for ores of both the precious and the base metals. The Germans call it an *eiserner hut* and the French a *chapeau de fer*, both meaning an iron hat. The iron may be present as a definite mineral, such as hematite or the hydrous oxide, limonite, but usually it is a mixture of oxides, and is distinguishable chiefly by its reddish-brown stain.

Among the signs by which the prospector is guided is the color of the rocks. Red means the oxidation of iron, in itself commonly an indicator of favorable conditions. A green coloration is likely to be due to the oxidation of copper minerals and may mark a spot rich in copper ore; but the experienced prospector knows that very little copper will serve to color a whole hillside, so he refrains from inferring too much. A black mass of rock, especially if it be a quartzose outcrop, is suggestive, because many silver lodes contain manganese minerals, such as

rhodonite and rhodochrosite, the oxidation of which gives a characteristically dark color to the outcrop, as was the case with the celebrated Granite Mountain vein, in Montana, and the even more celebrated Broken Hill lode, in New South Wales. The outcrops of the big masses of low grade copper ore in monzonite-porphry and schist are stained red and brown with iron, although in places they are white owing to the kaolinized feldspar or are splashed green by copper oxides. Thus the prospector must have an eye for color, as it were, and the color must not be in his eye, for if he be green from lack of experience, he will fail. Nor must the shades of pink or blue be present to excess in his perspective, for too much optimism may blind his discernment as too much pessimism may astigmatize his vision. He must have a good clear eye, to see things as they are, not as they might be; for in the end his ability to put two and two together, making it neither three nor five, but exactly four, is the beginning of that logical habit of thinking which transforms common sense into science.

The presence of particular minerals is suggested in some localities by the plants growing in the soil containing such minerals. Thus the *viola lutea* (a violet) was supposed to be peculiar to the soil covering the zinc deposits of Westphalia, in Germany, and it has likewise been found growing on the outcrops of zinc ore in Utah. It became known as the 'zinc plant'. Another supposedly indicative plant is the *amorpha canescens*, a small flowering shrub that characterizes the lead deposits of Michigan, Wisconsin, and Illinois. A convolvulus is said to indicate phosphorite in Spain. These plants are local varieties rather than distinct species, their color being affected by absorption of the particular metallic ingredient in the soil.⁴ Such facts are interesting, but the interest is chiefly academic, as they are of no practical value to the prospector, who usually will detect the mineral itself in the soil before he has noticed the supposedly indicative plant.

Much the same negative result has followed from the attempt to use the association of minerals themselves as a guide in prospecting. Quartz was supposed to be the true matrix of gold, until several rich veins lacking quartz had been overlooked, only to prove the depositories of immense wealth. For a time, especially in Western Australia, the presence of a telluride was accepted as a sure sign of the deep persistence of gold lodes. That generalization is now rusting on the dump of discarded fallacies. Roscoelite, a vanadium mica, was regarded as another indicator of gold in California and Colorado, until it was found too often unaccompanied by the precious metal. I met a pseudo-scientific gentleman at Coolgardie, in Western Australia, in 1897, who insisted that crocoite, the chromate of lead, was a sign of the neighborhood of rich gold ore. At Goldfield, Nevada, in 1907, after the association of the gold with alunite had been determined by F. L. Ransome, it became fashionable to quote the presence of alunite, or alum-stone, as giving

⁴'Indicative Plants', by R. W. Raymond; Trans. A. I. M. E., Vol. XV, p. 644. Also 'The Minerals that Accompany Gold', by T. A. Rickard, Trans. I. M. & M., Vol. VI, p. 194.

promise of profitable operations. Indeed, another geologist, my friend Robert T. Hill, found a vein containing alunitic in Arizona and spent a small fortune unsuccessfully in the confident expectation, which remained unfulfilled, of developing a gold mine. I might quote other instances less striking, but it is not worth while, because it is generally recognized now that such associations of minerals are untrustworthy as indications, except in a limited and local way. After all, the best sign of gold is gold itself; of lead, an ore of lead; of copper, an ore of copper; and so on. Where there is a little there may be more. Where there is none, the prospect is dismal.

One of the objectives of future prospecting will be the 'lost placers', namely, the undiscovered detritus of erosion from known lodes. For example, the Homestake lode enriched the Potsdam conglomerate of the Black Hills, and the erosion of the gold veins in the foothills of the Sierra Nevada made the famous placers of the Yuba and American rivers. But where is the gold that must have been shed by the Treadwell lode? Is it in Gastineau Channel? A. P. Coleman has suggested that the debris derived from the glaciation of the goldbearing rocks of Northern Ontario will be imbedded under the clay that extends to James Bay. A similar question arises concerning the veins that enriched known alluvial deposits. Where are the stumps of the veins that contributed to the placers of the Klondike and its tributaries? Were they wholly degraded in order to form the goldbearing gravel of Bonanza, Eldorado, and other famous creeks? What untold mineral wealth must lie buried under the ice and moss of the North, not to mention the glacial drift! What veins and lodes must be hidden from sight under the cement of the desert and the lava of the bad lands! It will be the business of the scientific prospector to pierce the blanket that Nature has laid over her treasures of ore, and he will exert his best skill in selecting the most likely places for exploring by means of the drill or other devices. Besides these chances there are the orebodies that have been lost by poor observation and bad mining. Many an orebody has remained undiscovered for lack of a cross-cut through a supposed vein-wall or by following the wrong geologic trail underground. I have often thought that if for a few minutes we were possessed of radio-active vision, enabling us to see through the rocks as if they were glass, we would be astonished to see how much ore had been missed by unskillful or unfortunate exploration. Lost mines exist in the very heart of some of our oldest districts.

Easy ways of discovering ore underground have been proposed, and many of them have been tried. They are typified by the divining rod, the 'dowsing rod' of the Cornish, the *virgula divinatoria* of Agricola, who said that the application of it "to metallic matters took its rise from magicians and the impure fountains of enchantment". Ever since the 11th century there have been men who claimed to detect the presence of metals underfoot by means of a two-pronged branch in the shape of the letter Y, each hand grasping a prong in such a way that the stem was free to turn. When they stood

above ore, the rod twisted until it pointed to the valuable mineral. Concerning such phenomena (a phenomenon is an appearance one does not understand) you and I can say that they are beyond our ken; but we shall agree with Hamlet that "there are more things in heaven and earth, Horatio, than are dreamed of in our philosophy". Of most of these 'dowsers' or 'diviners', however, it can be said, as Cicero said of the augurs in his day, that he could not see how two of them could meet in the street and look each other in the face without laughing.

A more intelligible, and therefore more scientific, method of divination is the use of the magnetic needle to find masses of iron ore. The dial-compass and the dip-needle have been employed successfully in the search for ore containing magnetite, in the Lake Superior region more particularly. The method is based on the familiar phenomenon of the attraction between a magnetized needle and iron; it is the application of the mariner's compass to navigation underground. The ironbearing formations contain magnetite, and this refers not only to orebodies but also to rocks containing sufficient magnetite to cause movement of the needle. Thus the dip and strike of the strata may be determined with considerable accuracy. The oxidation of pyrite yields products that are magnetic. Therefore it is possible to ascertain the position of contact-zones, and thereby to apply the method to prospecting for copper deposits, as has been done at Ducktown, Tennessee, by W. O. Hotchkiss, the State Geologist of Wisconsin.

The kindred phenomena of electricity likewise have been observed and adapted in many ways to the finding of ore. Of these there are many, as the records of the Patent Office will show. First is the method by measurement of electric resistance, whereby the resistance of the earth-circuit between two points is measured in order to detect abnormalities that point to the presence of orebodies. Another is the telephonic method, in which the passage of electric currents in the earth is observed. Yet another is the use of Hertzian waves, which traverse dielectrics but are absorbed or reflected by bodies that are conductors. A fourth method is that of potentials, that is, the production of an electric current between two points by means of a difference of potential, the variations to be noted being due to the differing conductivities of the minerals and rocks traversed, producing perturbations that are duly recorded by galvanometer. Among the causes of perturbation is polarization, on which yet another method of electric prospecting is based.

Suffice it to say that none of these methods has proved successful, although all of them are interesting and suggestive. The difficulty of making trustworthy inferences is due to the fact that water when present affects the conductivity of rocks more than the substances of which they are composed; the nature of the soil influences the results; the physical structure of mineral masses modifies the electric action just as much as their chemical composition; in some deposits the crystals in a mineral mass are separated by a coating of non-conductive matter. The information generally is not definitive; it is interesting but it does not accomplish the particular result

that the prospector has in view.² It is too much like the thin claret of which the Scot complained that it did not help him "to get forward". It is not quantitative.

The hazel twig as a means of divination may yet have as its successor some accurate method of finding ore. The alchemy of one age is the chemistry of another. I am quite prepared to believe that honest scientific investigation will succeed in devising a way of obtaining guidance for the miner in his prospecting by detecting and measuring the emanations, resistances, and other intangible reactions of matter on matter in such a way as to indicate not only qualitatively, but quantitatively, the presence of ore at a distance underground. Meanwhile, however, it remains for the prospector to use methods on which he can rely, rather than allow himself to waste his time and break his heart on schemes that are either inchoate or fraudulent. The core-drill and the diamond bit are well-tried tools; the shaft and the prospect-hole will not deceive; after all, the best instrument of divination is the pick. There is intelligent curiosity in the point of it; there is strength in the handle of it; there is rhythm in the swing of it. Do not be too readily persuaded to discard it for new-fangled tools of exploration.

The old-time prospector is becoming scarce, says the mining engineer. Conditions are unfavorable to his continued existence. In the first place, most of the easily found rich lodes have been located. The cream has been skimmed and only thin milk remains. The large low-grade deposits for which mining engineers and so-called exploration companies are seeking today are unattractive to the prospector because he cannot work them himself. In the old days he counted on discovering ore that was so rich that he could realize upon it, either by loading it on his burros and sending it to the nearest smelter or by treating it on the spot by means of an arrastra, a small stamp-mill, or some other simple metallurgical contrivance. If he needed a little working capital, he got it from the local merchant or saloon-keeper. Moreover, the kind of man that makes a good prospector is becoming rare because he was essentially the product of the frontier: he was physically strong, self-reliant, adventurous, and optimistic. He hated to work for wages, because he loved independence; so he roamed the unexplored wilderness with a quiet mind. Nowadays his successor cares less for the solitudes of the silent mountains and more for the hectic life of the noisy city; he is allured by the steady wages of industrial employment; he does not heed the call of the wild. Moreover the frontier and the unknown possibilities of mineral discovery that lie beyond that frontier have retreated farther and farther from the centres of population. The wireless telegraph has extended its invisible tentacles into the most remote parts of the wilderness. Any discovery is blazoned forth in the daily press within a day or two, thereby bringing a mob of pseudo-prospectors and speculators, who plaster the surrounding ground with their notices of location.

The railway and the automobile enable these others to interrupt the discoverer in his early digging before he has had time to select the best part of the deposit that he has uncovered; and with the eager crowd that camps on his trail there come the chances of conflicting rights, litigation, and technical troubles for which the true prospector has no heart. He finds out that the mining law fails to protect him; he may have to face the restrictive regulations of the Forestry Service; he may find himself in conflict with cattle-men, who invoke rights recognized by the Land Office; he may be told that his location is on railroad land. All that makes him tired; the old days for him are gone and in their stead is a world of red tape and petty irritation. Moreover, they have taken his whisky from him, and that is no joke. It was his one relaxation, the crown of his emotional life, the symbol of his good-fellowship. You may say that too much whisky spoiled many excellent prospectors and that the lack of it may sharpen scientific observation, but one must take men as they are, and there is no doubt that to the old-timer a bottle of whisky was as essential as a pick and a hammer. The 18th Amendment to him is a rank injustice; he is ready to quit, and he does. As to what becomes of him in that case, I do not know, any more than I can tell you what happens to all the pins that are lost or the old hats that are replaced by new ones; they just naturally disappear. There is a new fashion in prospectors as in hats. The sour-dough pioneer is succeeded by the sponge-cake scientist, says the cynic. The new men are of a different breed; less picturesque, more instructed; less self-reliant, better informed; less adventurous, more observant. They need qualities that their predecessors lacked, because they have to deal with new conditions. The world has grown smaller and more sophisticated; ore deposits have to be found not by stubbing one's toe against them but by induction from indirect evidence. To be successful nowadays as a prospector requires the aid of both science and capital.

In 1914 the 'Mining and Scientific Press' conducted a symposium on the question, 'What is the Matter with Prospecting?' A large number of engineers took part in the discussion, and it was remarkable how nearly they agreed on the chief points, namely, that there was plenty of money for the development of promising prospects, that Government aid was undesirable, that the chances of finding new ore deposits were becoming fewer, and that the public had been intimidated from subscribing to mining ventures on account of the deception practised by fraudulent promoters. All this may be true, but the fundamental fact remains that the genuine prospector has become a rare bird.

Various efforts have been made to assist systematic exploration for minerals. In 1911 the decrease of prospecting in Colorado became a subject of intense public interest, so much so that the Denver Chamber of Commerce solicited funds to be distributed among prospectors by a Grubstake Committee, which consisted of experienced operators and engineers. They selected the best prospectors and instructed them how to proceed on

²For my data on electric prospecting, I am indebted largely to a paper by C. Schlumberger, of the Ecole Nationale Supérieure Des Mines, published at Paris in 1920.

a campaign of scientific search for new ore deposits. Assistance was given to 34 prospecting parties, comprising in all 53 men, the sum of \$7400 being disbursed during the season from May to November. Altogether 43 locations were made, and on 11 of them good ore was discovered. In the opinion of the committee at that time these were "unusually good prospects, and easily warranted further development". The contracts provided that all locations were to be made jointly in the names of the Chamber of Commerce and the individual prospector, each having an equal share in the claims. The committee thereupon recommended the organization of a development company to exploit the most promising discoveries, and the Colorado Grubstake & Mining Co. was formed with a capital of \$250,000 in \$1 shares, of which \$25,000 went to the Chamber of Commerce for "fathering" the enterprise. The contributors to the original grubstake fund received fully-paid shares in amounts equal to their contributions, the remainder of the stock being sold at par to the general public. At the close of 1911 it was recorded:^a "The feeling generally prevails among leading mining men that the results of this attempt to stimulate metal-mining activity have already justified the efforts put forth". These expectations were not fulfilled; three years later it was announced that financial support was not forthcoming and the company was liquidated, all the money being returned to the subscribers. It was stated that the scheme proved unattractive to the public because it was "too clean" as compared with the allurements of 'wild-cat' ventures.

Among other attempts to assist the prospector I may mention that in Australia the State governments have made direct grants of money, they have erected small stamp-mills for the treatment of ore from prospects, they have shared the cost of exploratory work. In British Columbia the Provincial government has built trails and roads in outlying districts for the benefit of prospectors. In every English-speaking country the Government has endeavored to help by distributing geologic and other scientific information. Our Geological Survey and Bureau of Mines stand always ready to assist in every way within their powers. Such help is given with especial success in British Columbia, where officers of the Canadian Geological Survey stationed in a locality will make frequent visits to places where mining is in progress and will give hints based upon their knowledge of the regional geology.

Public opinion in the United States is opposed to the payment of direct monetary subsidies to prospectors, and generally dislikes what is dubbed 'paternalism', because it breeds interference as well as waste, if not graft. A Government subsidy to prospectors is deprecated, wisely; for, to quote an economist, the Government is merely 'all of us'; to ask the Government to assist a special class is to demand "what shall all of us do for some of us". That is not the spirit that made our country great. It is believed today that those in authority, whether of the Fed-

eral or State governments, can help best by furnishing maps, geologic data, and other useful information. At this point I may be permitted to echo the wish expressed at the Seattle mining convention last year, that books dealing with mineral exploration might be written in language more easily understood by those who desire the aid of scientific knowledge. I have heard many a prospector complain that the books he has bought have been almost useless because their language was as Greek to him, being interlarded with an excessive proportion of technical terms for which no explanation was given. Only those who have written on technical subjects know how difficult it is to write in simple English, and they have noted also that those who are the most thoroughly versed in the knowledge of their subject are the ones who can dispense with the jawbreaking words that repel the average reader. Certainly it would be a real kindness to the prospector if some enterprising publisher would undertake the task of issuing a set of three or four books prepared by the best scientific writers—for only the best can write on recondite matters in simple terms.

One reason for the lack of interest in prospects is said to be the "outrageous prices" asked for claims. This, I think, is said impatiently and without sympathetic understanding. Every prospector overvalues his prospect, just as every mother thinks her baby the most beautiful ever born. It is inevitable. However, it is a fact that many a prospector has lost a competence for life by asking too much for his show, only to find later that the ore-body petered out at water-level or became so refractory that its value was cut in half. Some of them seem unwilling to work on their finds for fear that they may undermine them in more senses than one. Many years ago I met an old negro in the woods near Breckenridge, Colorado; he seemed to be dazed; so I asked him if he had lost his way; to which he replied, "A prospector never gits lost". "Where is your prospect", says I. "Thaar", says he, "thaar's the best mine in the State, ruined by that damned nigger in Denver." "How's that?" "He put in a shot and blew out all the ore." The story has its variants, but it suggests the danger of doing too much work on a prospect when a buyer happens to be in sight.

What is wanting today is the link between the prospector and big capital, namely, the local storekeeper and merchant who used to back the man in the hills by grubstaking him, by giving him credit for supplies, and even by putting up cash when necessary. Another useful organization was the small syndicate that supplied similar financial stimulus locally. These are the wet nurses of the puling prospect; they nourish it until it is ready to be weaned financially and sufficiently developed to stand stronger treatment. It is then that the 'development' or 'exploration' company at some financial centre far from the mines should be approached with a view to business. The expense of sending a mining engineer a long way to make an examination is a mistake on the part of both parties to the transaction, and should not be incurred until the prospect has developed in character sufficiently to

^aM. & S. P., Dec. 23, 1911. 'Subsidizing Prospecting', by Walter A. Koch.

be appraised by a competent man. When prospects are too young, it is difficult to value them; it is too early to submit them to the burden of the heavy overhead expense inseparable from the system by which big companies conduct their affairs. Moreover, the local wise men, those experienced in the vagaries of local lode-structure, are likely to be better judges of a prospect, if they have no financial interest in it, than anyone coming from the outside.

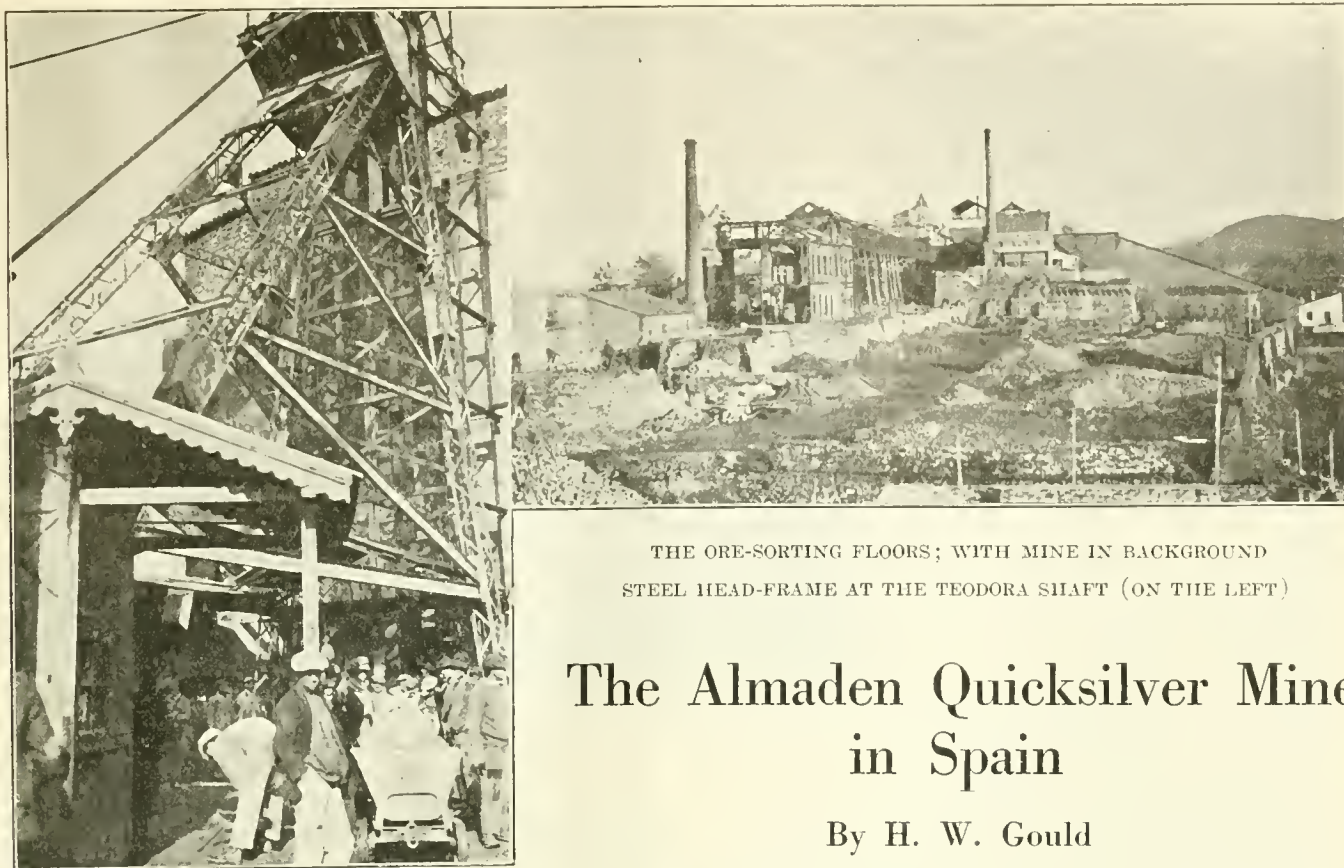
Here we touch a tender part of the subject. It is not given to every mining engineer to be a good judge of prospect; it is not everybody that can go to Corinth or see the *ornithorhynchus paradoxus* by moonlight; a good judge of prospects is a very rare bird indeed. The best judges are not the best educated men, unfortunately, otherwise we might count upon education to produce good valuers of prospects. It is as difficult to appraise the possibilities of a prospect as it is to discern the character of a man on a short acquaintance. Some people can do it; others cannot; and few can be taught to do it successfully. One reason why more new mines are not discovered is because the money for development is placed too frequently in the hands of ultra-conservative technical men who hesitate to incur the responsibility for which they have been retained. Too many prospects are condemned on reports that are read in an office without examination of the evidence that is available on the spot.

A bad report may be written on a good prospect. A keen nose for ore is not sharpened over a desk. One of the hopes for rich mines in the future arises from the condemnation of good prospects in the past. Another hope is that some day the owners of locations will be compelled to work them more thoroughly than is required by the annual assessment; and still another reasonable expectation is that the day may come when the owners of patented claims will be taxed into exploiting them or into selling them at a fair price to those willing to risk the chances inherent in mining enterprise. Government subsidies for mineral exploration are justified only when private or corporate initiative in such matters is dead, and that condition neither exists nor is it even to be anticipated in this country for many a long year.

The spirit of mining adventure will not die until our mineral resources are completely known and measured. Of that there is no sign yet. On the contrary, many parts of the United States remain but half-explored. To be specific, let me point to north-eastern California, south-eastern Oregon, northern Nevada, southern Idaho, much of Alaska, besides other large areas in the Western States. In Canada there is plenty of scope: the Labrador, much of British Columbia, the Hudson's Bay region, and the far North-West. An immense and most attractive territory remains to be explored in what the Canadian geologists term the pre-Cambrian shield, the terrain of ancient rocks in which the iron and copper of Lake Superior, the nickel-copper deposits of Sudbury, the silver veins of Cobalt, and the gold lodes of Porcupine have been found already. This pre-Cambrian region extends

into Arctic Canada, and is today probably the largest and most promising territory for prospecting to be found anywhere in the world. It is open to the English-speaking peoples, for the Canadian government, with exemplary generosity, allows the same right of location to Americans as to its own citizens. The extension of the railway to Hudson's Bay and the development of trade-routes through this vast wilderness will give the prospector access to this part of the North American continent, which, unlike many unexplored or partly explored regions, is free from the miasmas and other drawbacks of the tropics. Of Mexico, as a field for American and Canadian enterprise, I need say but little to our prospectors; for it is known to them and is intensely attractive to them. Undoubtedly, in the common phrase, Mexico has hardly been scratched yet. The land of the Aztecs and of the *conquistadores* remains one of the most attractive to the miner. It seems probable that the new government will succeed in restoring order and peace in a country from which our people have been compelled to absent themselves in large measure during the last decade; President Obregon has expressed himself hospitably toward Canadian and American mining exploitation, and I assume confidently that the call of Mexico will be heard by many a prospector and engineer in the days immediately ahead. Farther afield I need not go; other parts of the world invite the prospector, notably Siberia and South America, but on this occasion I prefer to restrict myself to the great North American continent.

Gentlemen, an old proverb says "the oxen farthest from home have the biggest horns"; the regions most inaccessible are often the most alluring; we of the Pacific Coast, however, need not cast longing glances too far afield, for we live at the doors of a mineral region second to none in interest, richness, and exploitability. We have the money needed for exploration; we have the men versed in mineral lore; all we need is the spirit of adventure, to which we owe our very existence as a commonwealth. In the old days the stockholders in the Cornish mines were called 'adventurers'; Prince Rupert and his friends, who organized the Hudson's Bay Company, described themselves as a "company of adventurers of England trading into Hudson's Bay"; of the search for mineral wealth it can be said, as of many other activities that are honorable and profitable, "nothing venture, nothing have"; risk is the essence of mining, risk with the chance of more than adequate compensation. To the men of this city, I would say: This beautiful city of Portland, this fruitful State of Oregon, are alike the product of that splendid series of adventures with which are interwoven the names of George Vancouver, Robert Gray, Meriwether Lewis, William Clark, John Jacob Astor. You are inheritors from a long line of men of wonderful spirit; see to it that their spirit is kept alive among you. Play your part in the development of your own mineral resources and aid your neighbors in developing theirs; look out; pro-spect. Seek and ye shall find; knock and it shall be opened unto you.



THE ORE-SORTING FLOORS; WITH MINE IN BACKGROUND
STEEL HEAD-FRAME AT THE TEODORA SHAFT (ON THE LEFT)

The Almaden Quicksilver Mine in Spain

By H. W. Gould

The Almaden quicksilver mine and the town from which it was named are situated in south-central Spain in the province of Ciudad Real, 11 km. from the station of Almedanejos, which is on the main line of the M. Z. A. railroad running from Madrid into Portugal. About 60 km. to the south-east is the silver-lead mining district of Penmarroya. The surrounding country is a high barren plateau, sparsely settled with the typically pastoral people of central Spain. The mine ranks among the world's greatest metal producers; the records in Madrid show a production since 1492 of 5,337,721 flasks, with the cost of production (per flask) since 1800. As authentic records indicate that the mine was worked as early as 200 B.C., and a map dated in 1610 shows a depth of about 700 ft., it is certain that the unrecorded production reached a high figure.

The ancient mine and the adjoining town of some 14,000 inhabitants, with its almost medieval appearance given by the old Castellano Morro, the Plaza de la Constitucion, the old churches, and interesting historical associations, produce a feeling akin to awe, even to a prosaic American engineer. The town lacks any system of sanitary conveniences; water is carried, by hand, on burros, or in ox-carts, from public wells. The mine is situated on the highest point of a long narrow ridge between the town, to the north-west, and the reduction-plant, or Cereo de Distilación, to the south-east. Both are surrounded by stone walls from 15 to 30 ft. high, and each enclosure has a great arched gate through which everyone must pass upon entering or leaving, and where a gate-man searches all employees as they go from work.

The mine enclosure is called the Cereo San Teodora and contains the principal working shaft, bearing the same name, the water-shaft San Aquilino, machine-shops, new power-house, mine-offices, large clean change-rooms, warehouses, and other buildings. The third shaft, the San Miguel, is in another enclosure. The buildings seem large for their purpose, and are substantially built of stone or brick. All the ore is hoisted from the San Teodora shaft, which is equipped with a modern all-steel head-frame, in strange contrast with a very old 200-hp. double-reel steam-hoist winding a $1\frac{3}{4}$ by $10\frac{1}{2}$ -in. flat braided hemp rope. The hoist is similar to those of the early Comstock type; the stretch in the hemp rope makes it difficult to 'spot' a cage on the 11th level, 300 m. below the collar of the shaft. The double-compartment shaft is brick-lined for the most part and is equipped with cages. The cars used are small, six- or seven-cubic foot capacity and 30-in. gauge. At present ore is hoisted only from the 10th and 11th levels through the main shaft, the 12th or lowest level being worked through winzes with Holman air-hoists of the 'little-tugger' type. Sinking of the main shaft to the 13th level is in progress at the present time.

The orebodies exist in three parallel veins about 25 m. apart in the lower levels. The formations in which the ore occurs consists of slates, interbedded limestones, and quartzites. The cinnabar occurs as a replacement in quartzite. The three veins named the San Pedro, San Francisco, and San Nikolas stand almost vertical, and average in width from 8 to 14 m. On the lower levels there is much native mercury or *azogue virgen*. The walls are hard, generally well defined, and permit the

making of beautiful stopes. Development work is carried on many years in advance of stoping, and thousands of tons of ore are blocked out ready to break. As all the ore mined has an average metal content of 8 to 10%, it is not uncommon to see stoping faces 25 ft. wide that will assay 25%; generally, little or no sorting is necessary. The workable ore-bodies are nearly 1000 ft. long, from 20 to 30 ft. wide; the official estimate of ore-reserves on January 1, 1920, showed a total of 15,000 metric tons of mercury or about 440,000 flasks. This report was undoubtedly conservative, and took no account of probable or possible ore.

Upon arriving at the 11th level one is first impressed by the lack of timber, all supports being of brick or stone masonry; the stations and drifts are arched with brick and are generally 20 or 25 ft. wide, and 20 ft. high in the centre of the arch. Some of the stations are very high and look like the interior of a cathedral. The stopes are well planned, with a masonry wall carried up at each end as the work progresses, the ground being filled as fast as the ore is mined. A space about 20 ft. long and as wide as the vein is left between the stopes, through which the ore is dropped to the level below. No chutes are used. The fine ore is handled in the stopes in closely woven wicker baskets; the coarse ore, by hand. On the main level the ore is shoveled into cars, trammed to the shaft, and hoisted to the surface.

All drilling is done by hand, though air-pipes are now being laid, and machine-drills will probably be used. Coarse rock for masonry walls is hauled from a quarry, about two kilometres from the mines. After the ore is hoisted to the surface it is dumped from the small ears and loaded on a gravity tram. This tram leads to the Cerco de Distilación; it is about 2600 ft. long, 400 ft. of which is over a steel trestle. At the end, the ore is dumped into an ore-building. It is then shoveled into ox-carts and hauled a short distance to an open sorting-floor or *planillo* where it is hand-cobbed, graded, and sized for the different furnaces. No rock-crushers or mechanical sizing devices are used.

The furnace or distillation plant consists of four 7- or 8-ton Spirek furnaces, two for coarse ore and two for fine (spoken of as the 'new', or modern plant, as it was built in 1902), and ten Bustamente intermittent shaft-furnaces (called the 'old' plant). These furnaces were all built between 1648 and 1654, and have been in almost continuous operation since that time. Four Spirek coarse-ore furnaces are now under construction. Ore from the *planillo* is trammed in small cars to the Spirek plant and hoisted to the charge-floor by an air-operated hoist. Ox-carts convey the ore to the Bustamente furnaces, as they are scattered and on a lower level. The Spirek furnaces are housed in a large steel and masonry building. The fine-ore furnaces are of the regular iron-sheathed type of Spirek in general use at Idria in Austria, and at Monte Amiata in Italy; roasting is usually efficient, Spanish soft coal being used for fuel. A special exit takes the mercurous fumes from under the top tile to the condensing-system.

The coarse-ore furnaces consist of straight shafts, the ore mixed with coke being charged through double doors. The fuel efficiency of these furnaces is said to be high. Both the coarse- and fine-ore furnaces are equipped with Cermak-Spirek condensers; there are two sets of six to each furnace. The fumes, after going through these condensers, enter a large common-brick chamber and pass out through a blower, thence through 500 ft. of subterranean brick-lined conduit to the stack.

The ten Bustamente furnaces are of special interest; they were introduced into Spain from Peru and were built by Bustamente himself; they have been in almost continuous operation for 275 years. Each furnace has a large cast-iron plate on the front above the fire-box, with name and date of erection. The San Juan is the oldest, built in 1646; the San Benito is the newest as it was first fired in 1654! They are of the double or twin-shaft type, charged through the side and top, and discharged from side and bottom. They are charged intermittently, fired, cooled, and drawn, the cycle requiring four or five days. The charge, about 20 tons, consisting of coarse ore, fine-ore briquettes, soot briquettes, and old broken *aludels* (subliming pots) is mixed with coke and placed in the furnace. A fire is then started in the fire-box with brush; about two days is required to burn the charge. The fumes leave the furnace near the top, and pass out through 32 lines of *aludels* that go down and then over the *aludel* floor to a brick chamber, thence through subterranean passages to the stack. The *aludels*, made locally, are shaped like jugs, are open at both ends, and are luted together with red clay. To clean them, the connection is severed, and the jugs are placed on end and the contents are emptied on the *aludel* floor. The soot is sifted with perforated hoes and re-charged.

The quicksilver runs by gravity to the silver-house or *almacen del azogue*. When the burned ore, or *escorias* is discharged from the furnaces it is loaded into ox-carts and hauled to the dumps. These dumps are enormous; they represent the accumulation of centuries, and the ore seems to have been well burned. Even the *antiguas*, as the oldest burned-ore dumps are called, show little cinabar or free quicksilver in the pan.

Assays for a period of years show an average loss in the *escorias* of less than 0.013% according to the mine records. Much has been said by European writers and metallurgists as to the heavy losses in the Almaden reduction plant but, in my opinion, these losses have been greatly overestimated. It is true that the old furnaces are saturated with mercury; the underground passages are catch-alls that have probably absorbed a large quantity, but a loss of 10% of the production for the last 400 years would mean about 500,000 flasks of quicksilver, and that seems an impossible loss where a plant is built on solid ground. A fairly well-equipped laboratory is maintained, and samples of furnace-heads and *escorias* are assayed each day, but the method of sampling is poor and the results are uncertain. The gold-cover method is used in making determinations.

The mercury from all the furnaces, Spirek and Busta-

mente, runs by gravity to the central *almacen del azogue*, a large and roomy masonry structure built in a square around a patio. In one room 14 square sheet-iron tanks each take the product from a furnace; the contents are measured daily. The mercury, drawn into a large central

gines, direct-connected to 250-kw. Brown-Boveri generators.

The Spanish labor is generally good, but improvements that appreciably reduce the number of men employed would be bitterly resented by the townspeople. The management has been considerably embarrassed during the past year by strikes. The last published report is for 1917. It gives the following distribution of labor:

Occupation	Number of employees
Mining	130
Building walls underground ..	348
Quarry for building stone	43
Preparation of ore	16
Sundry work above ground...	679
Furnace-plant	411
Undefined	47
Total	1674

This total does not include the men who are working on contract. The force in January 1921 averaged over 200 men.

concrete tank, is raised by a two-man hand-pump about eight feet, and flows in an open trough to the bottling-room, where it is weighed and bottled; it is then taken to the store-rooms. The flasks are then hauled by cart to the railroad station at Almadenajos; and, except for 1000 flasks per year reserved for the industries of Spain, is shipped to London and sold under contract by the Rothschilds.

On account of poor condensation the furnace-plant is operated for only seven months during the year, from October 1 to May 1, at which latter date the plant is closed for a general clean-up and for the effecting of such repairs as are necessary. The mine has been owned and operated by the Government for many hundreds of years; this is probably the reason for the retention of many of the antiquated methods used and for the large number of men employed. Moreover, customs and precedents, many of which are centuries old, are hard to overcome.

Though an average of only 70 or 80 tons of ore is treated per day (13,500 or 16,000 tons per year), the mine at present gives employment to more than 2000 men. This is partly accounted for by the fact that the men in the mine and reduction plant work four hours only per day, and eight days per month, and are paid full time. However, the present administration of the mine is progressive, and a comprehensive program has been outlined in order to bring the plant up to date. A power-plant is being installed which consists of two 300-hp. Sulzer Diesel en-

ten Bustamente furnaces treated, during that year, 7550 tons of ore, and made 984,486 lb. of quicksilver, burning 794,545 lb. of coke, 50,265 lb. of wood, and 22,500 lb. of brush. Four Spirek furnaces treated 5616 tons of ore, yielding 688,795 lb. of quicksilver, using 649,056 lb. of coke. The total production was 1,823,477 lb. of quick-



GENERAL VIEW OF FURNACES



FURNACE OF SAN BENITO, BUILT IN 1654 AND STILL RUNNING

silver, or 23,969 flasks. Production was said to have been curtailed on account of difficulty in obtaining empty flasks. The total ore treated was 13,166 metric tons, yielding 911.7 tons of quicksilver, a recovery of 6.93%.

In conclusion I desire to express my appreciation of the courtesies extended to me at the time of my recent visit to Almaden, both by the local director and sub-directors at the mine, and by the head of the Instituto Geológico in Madrid.

Book Reviews

Creative Chemistry. By Edwin E. Slosson. Published by the Century Co., New York. For sale by 'Mining and Scientific Press'. Price, \$2 50

The purpose of this book is to describe the recent achievements in the chemical industries. No previous knowledge of the subject on the part of the reader is assumed; and the author, who is a chemist as well as an editor, is to be congratulated on the appearance of an excellently written, well edited, and informative treatise. Although compiled in the style that marks many of the so-called 'popular' handbooks, it will, nevertheless, take its place among serious efforts to enlighten and educate the average man on the progress of the art, and the achievements of chemical specialists. The industry is fortunate in being able to call on writers like Slosson and Hendrick, both of whom possess the knowledge, as well as the happy knack of being able to impart it in an entertaining manner.

Professor Julius Stieglitz, in the introduction, emphasizes the fact that chemistry is the science of the transformation of matter. He advocates tariff protection of those of our chemical industries that are threatened with unfair overseas competition. Dr. Slosson divides human endeavor into three periods of progress: the appropriative, the adaptive, and the creative. We are now in the age of chemistry, with synthesis as the watchword. The need for artificial nitrogen products is emphasized in an early chapter. The Chilean nitrate industry forms the usual target for comment, so frequent among chemists who refuse, so long as a synthetic one can be made at any price, to see the economic advantages of a natural product. We are informed that Chilean nitrate is the result of the decomposition of guano; but the evidence in favor of so definite a statement is based on the flimsiest of assumptions. A scientific explanation of the presence of the nitrate has been proposed by De Kalb and elaborated by Whitehead; it deserves consideration. According to Dr. Slosson, the production of synthetic nitrates is now an assured success in Germany; 66,000,000 lb. per annum, at three cents per pound for fixed nitrogen in synthetic salts for the space of 25 years is the guarantee of a Berlin firm; and "Germany is now not only independent of the outside world but will have a surplus of nitrogen products which could be sold even in America at about half what the farmer has been paying for South American saltpetre". What the farmer "has been paying" and the price for which fertilizer "could be sold" are two very different matters. The inference is misleading. If Germany can make nitrates for so little how is it that Poland has to send to Chile for fertilizer? The facts would seem to indicate that even German economists were not above recognizing the worth of Chilean nitrate, when they can get it. Over 750,000 tons was imported into that country in 1913. During 1914 the amount must have been enormous; for, in addition to large imports before war was declared, Germany bought quantities from near-by countries, which in turn imported from Chile in amounts far in excess of agricultural requirements. If Germany could make synthetic products for three cents per pound of fixed nitrogen content, why the enormous pre-War expenditure for Chilean nitrate? And if synthetic nitrogen products can be made at such a price now, why the doubt, even in the minds of chemists, as to the commercial prospects of our own synthetic plants? No, the author of 'Creative Chemistry' is imbued, like many others, with the idea that the only way to ensure the success of synthetic nitrate is to belittle the Chilean industry. It is a stupid propaganda. We still need Chilean nitrate; we imported 1½ million tons in 1917. Dr. Slosson quotes the United States Department of Agriculture as the authority for the prediction that the Chilean nitrate beds will be exhausted

"in a few years". It is a pity that such statements cannot be tied to the name of an individual, whose knowledge of Chilean conditions might be investigated. If the Department of Agriculture is right, then certainly we are in a fix, but, happily, the Chilean government figures, which Dr. Slosson quotes and which in my opinion are conservative, give a life of 200 years. The actual life of the deposits, according to Dr. Slosson, is a matter of opinion; "which is largely influenced", so he says, "by whether you have your money invested in Chilean nitrate stock or in one of the new synthetic processes for making nitrates". So we are all down on the almighty-dollar basis in the author's estimation; and the opinion of those who have no money to invest is unworthy of attention. This seems to me to indicate a distorted viewpoint, calculated to obfuscate the issue.

Subsequent pages of the book deal in an interesting way with a number of fascinating subjects. The chapter on coal-tar colors includes a description of medicines, antiseptics, and photographic developers. There is no likelihood that the laboratory will rival the wheat field, we are reminded, but there is much scope for the synthetic production of the rarer and choicer products of Nature, such as perfumes and flavors. An interesting account of cellulose is given, together with details about the mercerization of cotton; the manufacture of collodion, the so-called artificial silks, near-leathers, and flexible fabrics of all kinds is also described. We have a score of trade names for the various synthetic plastics, all of which are considered in entertaining detail.

'The Race for Rubber' is the title of a chapter in which we are told of a German chemist's prediction in 1912 that synthetic rubber would be on the market in a short time. It meant, according to the author, "that Germany in war or peace would become independent of Brazil in the matter of rubber as she had become independent of Chile in the matter of nitrates". Any nation can be independent of Brazil in the matter of rubber, one could retort; for practically the world's supply comes from other countries. Germany is only independent of Chile in the matter of nitrate because she has no money to pay for the Chilean nitrate urgently needed. Dr. Slosson, with a strange disregard for the advocacy of synthetic rubber, suggests national interest in rubber plantations. The rubber tree was first studied in the Guianas, it is learned (and the statement is queried); they might be purchased; quien sabe? The United States has no colonial policy; we are dependent on foreign sources for all raw material. We are not told, however, that this is the fruits of isolation and a pretended disdain of territorial acquisition in tropical countries. Guayule rubber may help (but it is inferior to Para rubber). It might be cultivated in the southern States. We imported 7000 tons in 1911 and only 1700 in 1917. Over-exploitation is given as the reason for the decline. The story of Goodyear and the vulcanization of rubber is worth the repetition given it by the author. The subject of rubber is of interest to all. I notice that one reviewer was so carried away by Dr. Slosson's rhetoric that he 'handed a bouquet' to the chemists for the discovery of guayule rubber, the production of which he included among synthetic achievements!

The growth of the beet-sugar industry is described. The fatal mistake of dependence on a foreign country for essential supplies is well illustrated by the case of Great Britain during recent years. The discovery of saccharin, by Remsen, was accidental, we learn. The chapter closes with a delightful lapse into philosophical argument, with "sweetness" for the text. Fats and oils are essentials. As in the case of rubber, we need tropical possessions. Synthetic oil will never compete with the natural product of the coco-nut; but the chemists deserve praise for transforming vegetal fats into palatable and healthful food-products. The hardening of such fats by hydrogenation is described. We learn that the oleomargarine industry in New York was killed by

State laws; and that Federal legislation was responsible for reducing the output in the United States from 126,000,000 lb. in 1902 to 43,000,000 lb. in 1909. Concluding chapters deal with that most ghastly phase of modern warfare, the use of poison-gas; the rôle of the electric furnace in the manufacture of carborundum and aluminum; and the production of artificial diamonds. Metals, old and new, form the theme for an interesting chapter in which modern steels are described. The new 12%-chromium steel is referred to as "stainless cutlery". It is a pity, by inference, to so limit its application. One of the noteworthy features of the book is an excellent appendix of reading references, which indicates the generosity of the author, as well as the catholicity of his views. The book prompts the reader to think. It is educative and written in a delightful style. It is worthy of a better index.

A. W. A.

Compressed Air. By Theodore Simons. McGraw-Hill Book Co., New York. For sale by 'Mining and Scientific Press'. Price, \$2.

This is a revised edition of an excellent handbook on the production, transmission, and use of compressed air. The author, who is professor of mining engineering at the University of Montana, explains that the aim has been to provide the student, who is interested in technical questions concerning the operation as well as the construction of compressors and air engines, with a background of understanding that will enable him to solve the theoretical problems and to make independent research into the seemingly unlimited possibilities of compressed air. This new edition contained revised matter on air transmission, the effect of altitude, and many other important details. The book shows the marks of careful preparation. It is concise, and the subject matter is arranged in orderly sequence. It will be found of value as a reference book for those interested in mining or metallurgical work, or wherever compressed air is or can be used.

Recent Publications

Miners' Safety and Health Almanac, 1921. Bureau of Mines, 1920. 48 pp., ill.

Safety and Health Almanac for Miners, 1921. By R. C. Williams. U. S. Bureau of Mines, 1920. 48 pp.

Ventilation in Metal Mines. A Preliminary Report. By Daniel Harrington. Tech. Paper 251, U. S. Bureau of Mines, 1921. 44 pp.

State Mining Laws on the Use of Electricity in and About Coal Mines. By L. S. Ilsley. Tech. Paper 271, U. S. Bureau of Mines, 1920. 51 pp.

State Mining Laws on the Use of Electricity in and about Coal Mines. By L. C. Ilsley. Technical Paper 271, U. S. Bureau of Mines, 1920. 53 pp.

Gypsum in 1919. By Ralph W. Stone. II:8, U. S. Geological Survey, 1920. 14 pp. From Mineral Resources of the United States, 1919, Part II.

Lead in 1918. By C. E. Siebenthal. I:29, U. S. Geological Survey, 1921. 35 pp., 1 plate. From Mineral Resources of the United States, 1918, Part I.

Sand and Gravel in 1919. By R. W. Stone. II:10, U. S. Geological Survey, 1921. 14 pp. From Mineral Resources of the United States, 1919, Part II.

Quarry Accidents in the United States During the Calendar Year 1919. By William W. Adams. Tech. Paper 275, U. S. Bureau of Mines, 1921. 66 pp.

Causes and Prevention of Fires and Explosions in Bituminous Coal Mines. By Edward Steidle. Miners' Circular 27, U. S. Bureau of Mines, 1920. 75 pp.

Mining and Preparing Domestic Graphite for Crucible Use. By George D. Dub and Frederick G. Moses. Bull. 112, U. S. Bureau of Mines, 1920. 80 pp., ill., index.

Tenth Annual Report of the Director of the Bureau of Mines to the Secretary of the Interior for the Fiscal Year Ended June 30, 1920. 149 pp., 1 plate, ill.

Causes and Prevention of Fires and Explosions in Bituminous Coal Mines. By Edward Steidle. Miners' Circular 27, U. S. Bureau of Mines, 1920. 75 pp., ill.

Preliminary Investigations of Storage Battery Locomotives. By L. C. Ilsley and H. B. Brunot. Technical Paper 264, U. S. Bureau of Mines, 1920. 35 pp., ill.

Chlorination of Natural Gas. By G. W. Jones, V. C. Allison, and M. H. Meighan. Tech. Paper 255, Petroleum Technology 63, U. S. Bureau of Mines, 1921. 44 pp.

Coal in Eastern Idaho. By George R. Mansfield. Bull. 716-F, U. S. Geological Survey, 1920. 32 pp., maps. From Contributions to Economic Geology, 1920, Part II.

Mineral Resources of Alaska. Report on Progress of Investigations in 1918. By G. C. Martin and Others. Bull. 712, U. S. Geological Survey, 1920. Pp. 204, index, maps.

Geography, Geology, and Mineral Resources of the Fort Hall Indian Reservation, Idaho. By G. R. Mansfield. Bull. 713, U. S. Geological Survey, 1920. 152 pp., ill., index, maps.

Tenth Annual Report by the Director of the Bureau of Mines to the Secretary of the Interior for the Fiscal Year Ended June 30, 1920. Bureau of Mines, 1920. 149 pp., 1 plate, ill.

Phytoplankton of the Inland Lakes of Wisconsin. Part I. By Gilbert Morgan Smith. Bull. 57, Scientific Series No. 12, Wisconsin Geological and Natural History Survey, 1920. 243 pp., ill., index.

Forty-First Annual Report of the Director of the United States Geological Survey to the Secretary of the Interior for the Fiscal Year Ended June 30, 1920. U. S. Geological Survey, 1920. 180 pp., index, maps.

Gold, Silver, Copper, Lead, and Zinc in the Eastern States in 1918. Mines Report. By James M. Hill. I:11, U. S. Geological Survey, 1920. Pp. 5. From Mineral Resources of the United States, 1918, Part I.

The Lance Creek Oil and Gas Field, Niobrara County, Wyoming. By E. T. Hancock. Bull. 716-E, U. S. Geological Survey, 1920. 32 pp., diagram, map. From Contributions to Economic Geology, 1920, Part II.

Oil in the Warm Springs and Hamilton Domes, near Thermopolis, Wyoming. By A. J. Collier. Bull. 711-D, U. S. Geological Survey, 1920. Pp. 13, map, ill. From Contributions to Economic Geology, 1919, Part II.

The American Species of Orthophragmina and Lepidocyclus. By Joseph A. Cushman. Professional Paper 125-D, U. S. Geological Survey, 1920. Pp. 47, index, ill. From Shorter Contributions to General Geology, 1919.

The Fauna of the Cannonball Marine Member of the Lance Formation. Papers by Timothy W. Stanton and Thomas W. Vaughan. Professional Paper 128-A, U. S. Geological Survey, 1920. Pp. 66, ill. From Shorter Contributions to General Geology, 1920.

The Manufacture of Sulphuric Acid in the United States. By A. E. Wells and D. E. Fogg. Bull. 184, Bureau of Mines, 1920. 216 pp., 13 pl., 36 fig. For sale by the Superintendent of Documents, Government Printing Office, Washington, D. C. Price, 40 cents.

Cumulative Bulletin No. 2, January-June, 1920. Income Tax Rulings No. 656-1033, Inclusive. Bureau of Internal Revenue, Treasury Department, 1920. 339 pp. For sale by the Superintendent of Documents, Government Printing Office, Washington, D. C. Price, 25 cents.

Company Reports

SATOMAS COMPANY OF CALIFORNIA

Report for the year ended December 31, 1920.

Property: Butte and Sacramento counties, California.

Financial Statement: Gross returns, \$2,573,155.39; cost, \$1,670,508.82; net returns, \$902,646.57; profit before charging depreciation and exhaustion, \$104,242.69.

Production: 20,459,001 cu. yd. dredged for a gross gold recovery of \$1,680,675.37.

VICTORIA COPPER MINING COMPANY

Report for the year ended December 31, 1920.

Property: Mine and mill at Victoria, Ontonagon county, Michigan.

Operating Official: G. Hooper, superintendent.

Financial Statement: Total earnings, \$147,123.24; total cost, \$263,877.06; loss, \$116,753.82.

Production: 61,031 tons of ore milled for a production of 1,060,829 lb. of copper.

LA ROSE MINES, LIMITED

Report for the year ended December 31, 1920.

Property: mines and mill near Nipissing, Ontario, Canada.

Operating Official: G. C. Bateman, general manager.

Financial: gross value of ore produced, \$313,995.74; other income, \$54,981.39; expenses, \$355,697.40; net profit, \$13,279.73.

Development: 2336 feet.

Production: tons shipped, 1050.7; silver contained, 429,-356.97 oz.; value of cobalt, \$1173.89.

GOLDFIELD CONSOLIDATED MINES COMPANY

Report for the year ended December 31, 1920.

Property: Mines and mill at Goldfield, Nevada.

Operating Official: E. A. Julian, general manager.

Financial Statement: Earnings, \$33,455.34; expenses and losses, \$248,331.12; reduction of surplus, \$214,875.78.

Dividend: On September 15, 1920, a stock dividend was distributed, payable in shares of the Goldfield Deep Mines Co., on a basis of one share of stock in the Goldfield Deep Mines Co. for each share of stock owned by the company.

BARNES-KING DEVELOPMENT COMPANY

Report for the year ended December 31, 1920.

Property: Mines and mills at Marysville and Kendall, Montana.

Operating Officials: G. T. McGee, general manager; J. H. McCormick, F. L. Eccles, W. B. Cole, J. W. Johns, and A. B. Fox.

Financial Statement: Net profit for the year amounted to \$2739.39.

Dividends: \$60,000.

Production: North Moccasin, 9514 tons of average assay of \$7.62; Piegan-Gloster mill treated 34,573 tons at \$9.27. Tailing averaged 39 cents.

PORTLAND GOLD MINING COMPANY

Report for the year ended December 31, 1920.

Property: Mines and mill at Victor, Colorado.

Operating Officials: George M. Taylor, general manager; Fred Jones, assistant manager in charge of mine; Thomas B. Crowe, assistant manager in charge of mill; J. M. Tipsett, chief metallurgist; H. Wildman, metallurgist.

Financial Statement: Net profit from operations, \$76,-540.31; net loss to surplus, \$442,094.72.

Dividends: \$195,000; to date, \$11,692,080.

Production: 205,498 tons, yielding \$663,107.62.

General: The decision, on December 6, to discontinue dividends was due to shortage of labor.

BENQUET CONSOLIDATED MINING COMPANY

Report for the year ended December 31, 1920.

Property: mine and mill at Baguio, P. I.

Operating Officials: A. W. Beain, general manager; O. L. Kettenbach, superintendent of mine.

Financial: bullion account, P1,068,892.31; operating expenses, P473,372.46; profit on operation, P499,316.53.

Dividends: P300,000.

Ore-Reserves: positive, 27,100 tons valued at P\$60,000.

Production: 35,565 tons was treated of an average value of P33.23 per ton. The bullion production showed a recovery of 90.5% of the gold and silver in the ore.

HECLA MINING COMPANY

Report for the year ended December 31, 1920.

Property: Mine at Burke, Idaho.

Operating Officials: James F. McCarthy, general manager; C. H. Foreman, engineer; J. B. Sloan, mechanic.

Financial Statement: Income, \$2,573,840.08; expenditure and depreciation, \$1,285,882.56 and \$99,891.41 respectively; net profit, \$1,188,066.11.

Dividends: \$650,000; to date, \$8,505,000.

Production: 185,275 tons milled; 23,518.12 tons of concentrate shipped, and 10,682.24 tons of crude ore, valued at \$2,510,645.31.

Development: Ore-reserves are estimated at 2,095,745 tons.

BINGHAM MINES COMPANY

Report for the year ended December 31, 1920.

Property: Tintic district, Utah.

Operating Official: Imer Pett, general manager.

Financial Statement: Gross earnings, \$349,819.78; operating expense, \$141,515.05; net earnings, \$208,304.73; net operating gain, \$153,330.11.

Development: 6162 ft., Eagle and Blue Bell mines; 1314 ft., Yosemite mines; 1296 ft., Dalton and Lark mines.

Production: Dalton and Lark mines, 16,307 tons of lead and copper ore, returning 1927.64 oz. gold, 82,214.24 oz. silver, 311,287 lb. lead, and 479,242 lb. copper. Victoria mine, 12,068 tons of ore, returning 1503.767 oz. gold, 183,-063 oz. silver, 1,540,022 lb. lead, and 9787 lb. copper; Yosemite mines, 366 tons of ore, returning 22,526 oz. gold, 2508.89 oz. silver, 93,762 lb. lead, 6422 lb. copper; Eagle and Blue Bell mines, 26,640 tons of ore, returning 3178.51 oz. gold, 528,306.20 oz. silver, 5,408,375 lb. lead, and 1095 lb. copper.

Dividends: Blue Bell & Eagle Mining Co., controlled by the Bingham Mines Co., \$312,601.10.

HOLLINGER CONSOLIDATED GOLD MINES, LIMITED

Report for the year ended December 31, 1920.

Property: Mine and mill at Timmins, Ontario, Canada.

Operating Officials: A. F. Brigham, general manager; C. G. Williams, general superintendent; E. L. Longmore, mill superintendent; A. W. Young, production superintendent; R. T. Regnall, development superintendent; R. W. Robbins, mechanical superintendent; B. Richards, mine inspector.

Financial Statement: Total income, \$7,162,611.13; expenditure, \$3,144,328.73; operating profit, \$4,018,282.40.

Dividends: \$2,214,000.

Development: 18,103 ft.; ore-reserves as at December 31, 1920, were 3,294,005 tons valued at \$36,596,059, as compared with a valuation of \$37,693,450 on December 31, 1919.

Production: 650,205 tons of ore and 1156 tons of old concentrate was treated for a net return of \$6,219,664.80.

General: Increases in wages and the continued high prices of mining supplies have determined the policy of disregarding all ore of \$6 per ton or less in the estimate of ore-reserves.

REVIEW OF MINING

AMERICAN ENGINEERING COUNCIL MEETING AT PHILADELPHIA; HOOVER RESIGNS

The meeting of the executive board of the Federated American Engineering Societies, held at Philadelphia on April 16, considered sundry matters, the principal topic being the work of the Committee on Elimination of Waste in Industry. The meeting was followed by a dinner at which Herbert C. Hoover, Secretary of Commerce and president of the Federation, was present as the principal speaker.

The dinner was given by the Engineers' Club of Philadelphia and its fourteen affiliated societies with a membership of 4600 in Philadelphia and eastern Pennsylvania. The presiding officer was Guiliam Aertsen, of the Midvale Steel & Ordnance Co., president of the Engineers' Club of Philadelphia. The toastmaster was Major Joseph A. Steinmetz, past president of the Engineers' Club and chairman of the Aeronautical Section of the American Society of Mechanical Engineers. Mr. Aertsen, as president of the Club, presented Mr. Hoover with a certificate of honorary membership in the Engineers' Club of Philadelphia. Mr. Hoover's address followed. Dexter S. Kimball, Dean of Cornell University, vice-president of the F. A. E. S., and J. C. Trautwine Jr., editor of 'Trautwine's Hand Book', also spoke. Mr. Hoover's resignation as president was presented at the conclusion of the meeting and has been accepted.

PROMISING DEVELOPMENT AT THE BLUE HORSE MINE NEAR GOLDFIELD

Unusual and interesting mine development has just come to light in connection with the Blue Horse mine, 43 miles due east of Goldfield, Nevada. The claims are owned by a group of San Francisco men. About \$80,000 has been spent during the last year in stripping veins on the surface and sinking 30 to 150-ft. shafts along a vein 4 to 11 ft. wide that has been exposed over a length of 1500 ft. Exceedingly rich shoots have been found and shipments of high-grade ore have been made. A small mill was erected for experimental purposes and the tests have been so satisfactory that the company has started a vertical double-compartment shaft 300 ft. east of the outcrop of the main vein. This will be sunk to 300 ft., where cross-cuts will be driven to the veins. Specimens of the ore show free gold appearing with both ruby and brittle silver. The Blue Horse is 1½ miles east of the old camp of Silver Bow, on the west side of the Kawich range. According to Sidney H. Ball, of the U. S. Geological Survey, the ore deposits are in rhyolite, which in the vicinity of the veins is either kaolinized or silicified, the silicification being more common. The striking similarity of the deposits of this section and those of Goldfield also are noted by Mr. Ball. The district is attracting attention in southern Nevada and as the men sponsoring the Blue Horse appear able to carry through development on a large scale the work is being watched with interest. The officers of the company are J. W. Plant, Pacific Coast manager for the American Manganese Steel Co. and formerly superintendent of the Natomas Consolidated Dredging Co., president; W. H. Bissell, general manager for the Santa Cruz County Utilities, vice-president; and Frederic N. Lee, secretary. Among the other directors are J. W. Matson, of

the Honolulu Plantations Co., also prominent in Pacific Coast shipping circles, and George K. Allen, a Nevada mine operator.

COPPER SHARES SHOW STRENGTH

The strength in the copper shares is doubtless a reflection of the belief that the closing of the large copper mines will hasten an improvement in the price of the metal and thus permit the companies to resume profitable operation. However, at the current rate of consumption it will take many months to reduce the present surplus to a normal figure.

It is estimated that the surplus today is over 1,100,000,000 lb. in this country alone. The European surplus is not known, but, in view of the enormous tonnage of scrap-copper that has been shipped back to this country for refining, it is believed that the war copper has been pretty well disposed of.

With this surplus hanging over the market the future of the copper industry was not bright, in view of the fact that only 60% of the current production was being consumed, thus adding 40% of the production to an already large surplus.

With the production now averaging around 25,000,000 lb. per month, and the consumption 50,000,000 lb., the surplus, with mines closed, should be reduced to the extent of around 25,000,000 lb. per month, or at the annual rate of 300,000,000 lb. Of course the current rate of consumption is the lowest for years and any improvement in general business will add to the activity in the reduction of the surplus. The low price at which copper is selling should in itself stimulate consumption, especially if there is any increase in general business activity, yet the large surplus now on the market may prevent any marked advance in the price, so that the mines that have remained open will not obtain much advantage over those that have closed.

MINERS STRIKE AT TONOPAH

The Tonopah Extension, Tonopah Belmont, and MacNamara mines at Tonopah are shut-down on account of the strike of miners, millmen, machinists, and hoisting engineers that commenced April 16 when the wage-cut of 75 cents per day went into effect. The West End, Halifax, and North Star companies made no reduction in wages and are operating as usual. The action of the operators in ordering the reduction was taken at a time when the district was filled with men from Ely and other copper-mining districts where the mines are closed. The operators point out that wages were increased \$1.50 from December 1, 1916, to October 1, 1919, when the last advance was given. They say that in the last six months the cost of living has been reduced 20% through operation of a store by them and that, even with silver at \$1 per ounce, they are making little profit. The employees claim that the cost of living has not been reduced. The following scale of wages is provided in the new schedule: machine-man, underground, \$5.25 per day; shoveler, \$4.75; blacksmith, \$5.75; helper, \$4.75; electrician, \$5.75; hoist engineer, \$5.75; lathe-man, \$6.25; machinist, \$5.75; helper, \$4.75; motorman, underground, \$5.25; motorman, surface, \$4.75; ore-sorter, \$4.75; pipeman, \$5.25; powder-

man, \$5.25; timber-tramer, \$5.25; tool sharpener, \$5.75; helper, \$4.75; trammer, \$4.75; topman, \$4.75; truck-driver, \$5.25 and \$5.75; helper, \$4.75; watchman, \$4.75. The proposed schedule for millmen would be as follows: conveyorman, \$4.75; crusher man, \$5.25; battery-man, \$5.25; battery-repair man, \$5.25; filter operator, \$4.75; fireman, \$5.25; mill laborer, \$4.75; offer, \$4.75; pipe-fitter, \$5.25; rednery-man, \$5.25; solution-man, \$5.25; solution-helper, \$4.75; table-man, \$5.25; tube-mill man, \$5.25.

COPPER SALES FROM THE LAKE REGION

Calumet & Hecla has started to fill a million-pound copper order recently received from Germany, the first shipment having gone forward. The entire consignment will be made up of 6600-lb. cakes, which will be used in the construction of locomotive fire-boxes. These cakes and those ordered from Copper Range, of 5500 lb. and over, are the largest ever called for at the local smelters. They require the use of special frames for casting and rigging for loading on cars. This is the largest order for export received by Calumet & Hecla since before the War. Its export business since the War has been negligible, averaging not more than 150,000 lb. per month. In former years the company enjoyed a large foreign patronage, depending on the European market, especially that of Germany, for disposal of 60 to 70% of its production. The order just received may mark the return of Calumet & Hecla to the foreign market; if so, big inroads will be made in its surplus. Since the War, Copper Range has been the only Lake Superior company to sell much copper to Europe. It has filled two large orders to date and the third, for 1,600,000 lb., is now being shipped. This metal goes to Germany. It is the largest order received by this company since before the War. None of the other companies are making extensive sales of copper. Mohawk and Wolverine are making irregular shipments for domestic account, but in comparatively small quantities. Calumet & Hecla domestic sales also are small. Quincy copper is moving but slowly, one Michigan concern absorbing a large quantity. Some of the smaller mines have copper piled up on the local docks of from 100 tons upward.

ALASKA

Kennecott.—The latest reports are to the effect that the mine will not be shut-down, but for the present, at least, operations will be maintained at the rate of 7,000,000 lb. per month. The annual report for last year shows an average cost of 10.8c. per pound for producing 108,000,000 lb. of copper, this including depreciation and local and Federal taxes.

ARIZONA

Ajo.—The properties of the Gunsight Mines Co. south of here are to be operated. Thirteen men are now employed in erecting buildings. The necessary machinery has been ordered. Most of the work is being done on the Burro group of claims in the Myers district. The cyanide plant at Walls Well is to be moved to the new point of operations. The company recently acquired a promising silver property thirty miles from Ajo. Development work is to be started at once. The ore is said to assay 40 oz. in silver per ton and to contain some copper and gold. A. W. Bramwell is manager.

Bisbee.—Official announcement that the Calumet & Arizona Mining Co. will suspend the production of copper was made here on April 11. About 15,000 tons of ore per month will be mined and stocked, and the company will retain about 575 men in the operation of the mines. The smelter at Douglas was closed on April 15. With the Copper Queen retaining about 1000 men on development work and upkeep there will be more than 1500 men at work in the

mines of the district in spite of the suspension of production. Forces of the New Cornelia Copper Co. at Ajo, under the same officers and directors as Calumet & Arizona, will be reduced from 522 to 300. At the meeting of the board of directors of the Calumet & Arizona, Charles Briggs, for 20 years president of the company, announced his resignation. He is succeeded by Gordon R. Campbell, of Calumet, Michigan, formerly secretary.

Globe.—The Miami Copper Co. has no intention of closing down, according to a statement made by the management when called upon by the grievance committee of the miners. The cost of production for the Miami Copper Co. is remarkably low, having been given in the past at less than 12 cents per pound.

Kingman.—Development, by Charles Sutro and associates of San Francisco, of the Katherine property in the Union Pass district has been attended by favorable results in a series of main and cross fissures. The townsite of Katherine has been laid out. Both in the shaft and drifts the rock formation is such that no timbering is required. On the 100-ft. level the ore-shoot is 287 ft. long, 15 to 35 ft. wide, of an average value in gold of \$11 per ton. There are wide lenses in the vein on the first level, where the gold content ranges as high as \$100 per ton. On the 200-ft. level the ore-shoot east of the shaft is 533 ft. long, 31 to 67 ft. wide, carrying \$14.45 in gold. On the 300-ft. level the shoot, as far as has been determined, is 483 ft. long, 32 ft. wide, with an average value of \$11 gold per ton. On the 400-ft. level the east drift has been driven along the shoot for a length of several hundred feet, but in the absence of cross-cuts the management credits the workings with no tonnage at that depth. Above the fourth level the ore blocked out totals 190,500 tons. Sutro also owns a large interest in the Sheep Trail and other properties in the section. A contract has been let for 400 ft. of work in the Sheep Trail tunnel. Others who are operating in the Union Pass country include Charles N. Miller, who has let a contract to sink a main working shaft on the Katherine Extension property to a depth of 200 ft., on the extension of the Katherine vein; John B. Tegloan, former superintendent of the MacNamara mills at Tonopah, who has optioned two groups of claims from the Lucky syndicate; M. Page, Nevada and Mother Lode man, who has placed the Gold Chain property with San Francisco mining men and is equipping it with machinery, and who also has the Black Dyke group under option; A. J. Jennings, who has purchased the Katherine Mohawk Extension group for a syndicate of Montana mining men; State Senator James Curtin, of Kingman, who has purchased five claims east of the Gold Chain for himself and Phoenix associates; Tony Vrang and associates, who have secured a group of claims paralleling the south sideline of the Mohawk property; A. L. Degenhart, who has secured the Katherine Mohawk group for F. T. Torpey and others of San Francisco; and Henry Johnson, who has resumed work on the Oatman Revenue group.

Oatman.—It is reported that the Tom Reed Gold Mines Co. has opened a large body of ore in the Sideline vein on the 400-ft. level of the Grey Eagle claim. This is the vein that was divided between the United Eastern and the Tom Reed companies by the recent decision of Judge Bollinger. The ore exposed is said to be rich in gold.

CALIFORNIA

Amador City.—Two electric pumps have been installed at the Fremont Consolidated, now controlled by the Buikley Wells syndicate. Underground operations are to be undertaken shortly and B. I. Hoxsie, superintendent, expects to have the 40-stamp mill in operation before the end of September.

Melones.—The new 10-stamp unit of the 30-stamp mill

at the Carson Hill mine is operating. By lowering the discharge of the stamps one inch, a gain of one ton in the stamp-duty has been made. The new mill averages 19 tons per stamp as against 18 in the old units. Ten of the old stamps are hung up for repairs. This mine is said to head the list of gold producers in the United States.

Angels Camp.—The Finnegan mill is completed, with the exception of the concentrator floor. Stamps will begin to drop by June 1. The raise which was completed to the surface from the lowest level (the 600) is to be used for a shaft and the ore from the shoot, now being rapidly developed, will be carried through this raise to the mill. There is considerable excellent ore on the dump.

Grass Valley.—According to C. A. Brockington, manager of the Allison Ranch mine, the extension of the Caribou ore-shoot has been found in the extreme south drift on the 600-ft. level. A corresponding drift on the 800-ft. level is being driven to catch the same shoot. If this is successful an immense block of ore will be available. The mill has been started and ore from the stope above the 600-ft. level is being treated. The mine was re-opened in 1917 after being idle for 20 years.

Placerville.—Erection of a mill is proceeding at the Grit gold mine, at Spanish Dry Diggings. Several rich ore-shoots have been exposed and sufficient ore developed to ensure a long run of the mill.—Owners of the Five Pines and O. K. mines are installing equipment, and at the Lee group good ore is being mined. Sinking of a 500-ft. shaft is proceeding at the Crabtree group with the purpose of opening continuations of rich veins formerly worked.—The last raise from the Andesite tunnel in the Double O mine has entered pay-gravel, and drifting is being carried on to determine the extent of the deposit. The channel is thought to be a branch of the old Devil's Basin channel that produced \$1,000,000 gross in the early days.

Porterville.—Through a series of transactions lately consummated the principal magnesite deposits and plants in this district have become consolidated as a new company known as the Sierra Magnesite Co. This company is headed by Stanley H. Barrows, of Chicago, president of the National Kellastone Co. Arthur Deleray will act as local superintendent. Magnesite properties taken over by the new company include those of the Porterville Magnesite Co., four miles north-east of this city, and several adjacent magnesite deposits which the company has leased; the property of the Tulare Mining Co., ten miles east of there on the P. & N. E. branch of the S. P. railway; the calcining plant in this city, built by the American Magnesite Co. and more recently operated by the C. W. Hill Chemical Co., of Los Angeles. The raw ore will be hauled by motor-truck to the company's main plant in Porterville, which will be equipped with additional machinery. When the main plant of the Sierra company is fully equipped this company will be able to turn out magnesite in all its marketable forms, including crude ore, calcined-lump, calcined-powdered, and dead-burned magnesite. Last year's government survey showed

that the Porterville district produced the greatest amount of magnesite of any district in the country. The new company will employ from 150 to 200 men regularly, and expects to do a \$1,000,000 business annually.

Redding.—It is expected that the smelter of the Shasta Zinc & Copper Co. will be ready for operation about July 1. The experimental plant has been in operation for several weeks and has demonstrated the success of the proposed process for making zinc-oxide. The residue from this treatment will be smelted to recover the copper, silver, and gold. The Bully Hill mine, owned by the company, has been opened



Head-Frame at Central Shaft, North Star Mine, at Grass Valley

to a depth of 1000 ft. and large reserves of complex zinc-copper ore have been developed. D. C. Jackling and associates are financing the enterprise.

Development of bonanza gold ore is reported from the Juniper mine, at Hayden hill. The vein has been exposed for over 215 ft. and is about 12 ft. wide, with the material running from milling grade up to \$1500 per ton in gold. The mill has been running steadily since February 12. The Juniper was re-opened about two years ago after a long period of idleness.—Construction of a two-mile ditch is proceeding at the Spooner hydraulic mine, near Cecilville. The ditch replaces the old flume and will deliver water to the glants nine months of the year. Extensive areas have been opened to the glants and next season is expected to prove the best in the annals of the company.

COLORADO

Aspen.—Official confirmation of the strike in the Hope tunnel is made in a letter addressed to the stockholders of the Hope M. M. & L. Co. Assays on a spar vein, cutting across the tunnel at a pitch of 78° W., are reported to show 174 oz. silver for the lower portion and 1047 oz. for the upper portion of the 2-ft. vein. Black lime between these contained 48 oz. The ore is now being broken, sacked, and stored until the roads are open early in May. The drift has been carried on the vein for a distance of 35 ft.—Ore will also be shipped when the roads are open from the Aspen Silver Lead Co.'s property on Porphyry mountain.

Greenknidge.—The Royal Tiger Mines Co. is contracting all underground work and is employing about 45 to 50 men. Sinking is also to be resumed on its recently acquired property adjacent to the Wellington mine.

Central City.—The Gorman mine shaft is being unwatered; the 200-ft. level has been reached.—Ore shipments were made during the week from the Fairfield, Druid, and Gold Rock mines.—The Eureka shaft of the Glimp-Eureka is being unwatered and the mill overhauled, preparatory to resumption. A new mill is planned for the Sitka property; grading of the millsite has been started.—The Brooklyn group above Central is to be developed by the Silver Gem Mining Company.

Cripple Creek.—March production showed an increase of \$29,718 over February figures, with 46,766 tons treated of an average value of \$12.72 per ton and a gross bullion value of \$594,608.—Returns from the Hardwood mine lease on Ironclad hill, operated by T. R. Countryman and associates, for the first two cars of ore shipped show \$139.20 and \$120.50 per ton. Royalties paid to the United Gold Mines Co. aggregated \$2700.—The Isabella Mines Co., to encourage leasing, has reduced royalties 5%. Lessees may now work either on a scale graded from 10% on \$10 ore to 30% above \$75 per ton, or on a flat royalty of 25%.

Idaho Springs.—A contract for 100 ft. of tunnel extension on the Neptune mine of the Osborne group has been let; work has started. The property was recently taken over by E. C. Condit, of Silverton.—C. R. Francis, manager for the Lincoln Mines Co., has taken over the Bellman mine; a shipment of 100 tons was made last week to the Hudson mill.

Ouray.—Operations are to be resumed shortly on the Wanakah mine on East Gold Hill by the Ouray M. & M. Co. and production will start by June 1. The mill is also being overhauled and new machinery added.

IDAHO

Coeur d'Alene.—The New Caledonia Mining Co. is pushing development. At present the work is confined to cross-cutting the vein recently found at a depth of 450 ft., which carried silver and lead. The vein was entered from the hanging-wall side and has been cross-cut 20 ft. with no indication of the foot-wall. The work has been progressing at the rate of 5 ft. per day. The New Caledonia has 16 claims.

The Callahan Zinc-Lead Co. has started a shaft to reach an additional depth of 200 ft. The present labor situation justifies development and the company is taking advantage of it to put its property in good shape. With the wage-scale reduced somewhat and many idle miners eager to secure and retain jobs, mine managers say that they are able to get at least 40% more work for their money than was possible six months ago.

Three shifts, with a total of 30 men, are being used in sinking the shaft, which will go from the No. 10 level, 1250 ft. below the main working-tunnel of the mine, to a new low level to be known as No. 11. Less zinc and more lead is found on the lowest levels opened, although zinc still predominates. Since the company ceased producing and shipping, it has had men raising from the No. 10 level toward

the No. 9 level. The raise was extended 126 ft., following the hanging wall. A cross-cut to the foot-wall then was made and the vein found to be 14 ft. wide with good milling ore.

According to surveys, and allowing for the dip and strike of the vein, the orebody should be cut within the next 100 ft., officers of the North Bunker Hill Mining Co. declare. Good progress is made in the work, the miners advancing an average of four feet per day.

Elk City.—Owners of the Mother Lode mine in the Oro Grande mining district have purchased a 160-ton mill. The Mother Lode is a free-milling gold property, with a shaft sunk 50 ft. on the hanging wall, and a second shaft of 35 ft., with a 150-ft. cross-cut and a tunnel 800 ft. long. Assays show a content of \$12 per ton and upward.

Hayden Lake.—Development work has started on the Chilko Mining & Milling Co.'s group of 11 claims, nine miles north of here. A two-drill compressor will be installed so that work will be done by machine instead of by hand. The other drill will be used to start a tunnel 200 ft. lower on the vein, which is expected will cut a chimney of ore which was found in the present tunnel not far from its mouth.

MICHIGAN

Houghton.—Quincy is working now only four days per week and production is about 25% of normal. A few men are giving up their jobs to go to the farms or take up other work, and their places will not be filled, as the management has adopted a policy of strict retrenchment. The daily output of 'rock' has been steadily decreasing until now it is considerably less than that of Mohawk. Were it not for the fact that a shut-down would entail a heavy expense in keeping shafts and underground openings in condition, Quincy no doubt would stop production entirely.

Mohawk and Wolverine continue to keep the six heads in the two mills busy, Mohawk sending 2600 tons of 'rock' daily and Wolverine 1000. Mohawk is getting some fine looking rock from its north drifts from the three bottom levels of No. 1 shaft. Drifts are still being driven south to connect with No. 4 and as soon as these connections are completed the work of mining the new ground north and south can be speeded through the use of electric locomotives now employed in No. 4 only. Mohawk is using stope- and level-scrapers to advantage and has developed them to a high state of efficiency. Seven stope-scrapers are in use and one level-scraper on the 15th level south of No. 6 shaft. Other mines in the district have given attention to stope- and level-scrapers, particularly Calumet & Hecla. Just before the shut-down six stope-scrapers were turned out of the Calumet shops for Ahmeek and twelve of similar type for the Calumet conglomerate workings. These devices will play an important part in operations when mining is resumed. Ahmeek in the future will make its own scrapers, its shops having been equipped for that purpose. Both Mohawk and Wolverine are full handed and production will be kept at capacity. The more recent cut in wage is equivalent to 1½c. per pound reduction in costs, which will enable Mohawk to make a profit on present operations and cut Wolverine loss to about 1½c. per pound.

At the Victoria mine in Ontonagon county the force of 70 men is engaged in cleaning up ground broken in the stopes. No active mining is under way. The rock runs only 10 to 11 lb. per ton. Victoria's costs are comparatively low owing to the use of hydraulic power, which enables it to handle rock of small copper content. The property will be kept open, for it is realized difficulty would be experienced in building up an organization if it were to close only for a few months. The company has a considerable metal surplus and is making no sales. At the recent annual meeting in New York the old board of directors was re-elected.

The east cross-cut from the 1700-ft. level of the May-

flower, which has been in vein-rock for several weeks, is getting into trap. However, the cross-cut will be continued in the hope the vein will become strong again. It is planned to drive southward on the vein formation at the point where it shows up the best in metal content. Drifts north and south also will be driven in the vein formation from the west cross-cut.

It recently was reported that the Isle Royale mine had been shut-down for a period of two years, but this rumor is officially denied. The mine will remain closed no longer than necessary and will resume with other Calumet & Hecla subsidiaries when market conditions warrant the step.

MISSOURI

Joplin.—Approximately 100 employees of the Eagle-Picher company resumed work when the company re-opened its sublimed white-lead department and the blast-furnace unit in the Smelter Hill plant.

J. Edward Webb, general manager for the company, says: "The company had in mind, of course, the welfare of its employees, but also had good business reasons for its action. Stocks have begun to run low in the divisions that are resuming operations, back of which is a story of increased demand. As far as I can see, the sublimed white-lead department and the blast-furnaces will be able to continue in operation." Success of a mixed-metals department recently opened by the company has been gratifying, the operations promising employment to an increased number of men. Following its custom, the Eagle-Picher company has again adopted the 'daylight-saving' plan by moving the hands of the clock ahead an hour. Office workers are thus liberated from their desks at 4:30 o'clock in the afternoon.

MONTANA

Butte.—The annual report of the North Butte Mining Co. shows a deficit from 1920 operations of \$576,233, compared with a profit of \$563,408, equal to \$1.30 per share, in 1919. The production of the company during 1920 consisted of 16,666,819 lb. of copper, 693,633 oz. of silver, and 1004 oz. of gold. This contrasts with 14,331,254 lb. of copper, 633,214 oz. of silver, and 914 oz. of gold in the preceding year. The cost of producing copper last year was 17.64c. per pound, compared with 14.85c. in 1919 and 20.19c. in 1918.

The annual report of the Butte & Superior Mining Co. shows a large decrease in the reserves of ore. The following statement is included in the report:

"On account of the shrunken ore-reserves your directors thought it desirable, in addition to continuing development work to acquire for the company an interest in other proved orebodies of a more or less similar kind. Accordingly 36,000 shares of the capital stock of the Shasta Zinc & Copper Co. were purchased for \$360,000, being the original issue price. The Shasta Zinc & Copper Co. is a Delaware corporation with a total authorized and issued stock of 200,000 shares of no par value. The company acquired the property formerly owned by the Bully Hill Mines, Inc., located at Winthrop, Shasta county, California."

Helena.—The American Smelting & Refining Co. will continue to operate the lead smelter at East Helena. It is believed that the shutting-down of the mines at Butte will stimulate the operation at small mines and prospects and encourage leasing in various gold-silver districts in Montana. This will have the effect of increasing small shipments to the smelter.

Townsend.—At the Iron Mask mine a ventilating shaft is being raised to the surface as rapidly as possible. A 3-in. drill-hole will later be driven to connect the old workings with the shaft.

NEVADA

Battle Mountain.—An 18-ft. width of ore, 5 ft. of which assays \$60 and the remainder \$15, has been opened in the

No. 3 tunnel of the Betty O'Neal, 12 miles south of here. This tunnel is 800 ft. long. Ore 4 to 15 ft. wide and assaying \$35 for this width is exposed in the No. 2 tunnel, and there is a 10-ft. face of \$30 ore in the No. 4, or lowest, tunnel. The mine also is opened through a 400-ft. shaft, and another tunnel, to cut the vein at 400 ft. below the bottom of the shaft, is to be driven. It is planned to build a mill when this tunnel has been completed. The Betty O'Neal was first operated by the father of Noble Getchell, who is now in charge of the work.

Millers.—The Carrie Silver-Lead Mines Corp., owning five well-equipped claims 10 miles north-west of Millers, has resumed work, according to C. R. Murdoch, secretary and consulting engineer for the company. The mine is opened through a 235-ft. inclined shaft, with levels at 175, 205, and 230 ft. The vein, a contact between granite and limestone, has produced \$50,000 worth of high-grade silver-lead-copper ore, largely boulders found in the drag from a fault. Three shoots of low-grade leached oxidized ore have been found on the upper levels and a search for these is to be



Calumet & Hecla's No. 5 Shaft

made at and below the water-level, which is at a depth of about 235 feet.

Simon.—The mill of the Simon Silver-Lead Co. will be ready for operation by May 10, but it will not be started until August or September, when the power line will be completed.

Sulphur.—The Red River Lumber Co., of California, has completed a retorting plant; production will soon be started after an expenditure of \$150,000 in mine development, experiments, and construction of the plant. The sulphur will be sold for fertilizer and for use in paper mills.

Round Mountain.—The Round Mountain during March washed 30,000 tons of gravel, using one 5-in. giant 24 hours daily. The first two clean-ups, from the head-boxes, gave a return of \$17,500. The Gibraltar Silver Mines Co., owned by the same interests as the Silver Hills, operating in Tule canyon, south of Goldfield, has resumed work on the Gibraltar, in Jett canyon in the Toiyabe range. This company first started work late in 1919, but stopped soon after driving a tunnel into the outcrop of a vein of extremely hard quartz several hundred feet high. Big widths of low-grade gold ore, with rich seams, were found on the surface, but the results obtained in the tunnel were unsatisfactory; when work was stopped it was said that the proper method of development would be to sink a shaft out of the vein and cross-cut to it at depth.

Sweetwater.—The Silverado mine, which was taken over several years ago by Chicago interests, is to be equipped with

a 150-ton cyanide plant and its own electric power plant during the current year, according to A. G. Anderson, of Chicago, president of the Nevada-Progressive Mining Co., which owns the property. E. F. Hall is general superintendent. For two years the property has been undergoing development during which time its ores have been treated in an experimental plant erected upon the ground.

The new mill will be built about 6000 ft. from the mine from which the gold and silver ore will be transported by means of an aerial tramway, which is one of the new improvements to be made. At least \$250,000 will be expended in equipping the property.

Virginia City.—The United Comstock has completed 3000 ft. of the 9000-ft. tunnel being driven by that company. The company employs nearly 200 men.

UTAH

Alta.—Ore carrying 107.6 oz. of silver and 76% lead has been opened in the Alta Tunnel & Transportation Co.'s property in Big Cottonwood canyon. A sampling of the intermediate ore lying along the edge of the high-ore carried 11% lead and 21.6 oz. silver. A sample of the fine carried 29% lead and 16.4 oz. silver. F. V. Bodfish, manager, reports that a greater part of the face consists of high-grade ore. From the old Prince of Wales mine, the main workings of which lie above the recent find in the Alta tunnel, a large amount of ore was taken out by the Walker brothers. The ore was struck at an intersection of the Prince of Wales fissure and an extensive brecciated zone of limestone.

Beaver County.—Plans were made at the recent annual stockholders meeting of the Utah Sulphur Corp. to take immediate steps to increase the efficiency and output of the plant at Morrissey. Building of a new refining plant, using the distillation process, will be begun June 1, according to M. P. Morrissey, the president of the company. When completed, the plant will have an output of 50 tons of refined sulphur, 50 tons of brimstone, and 50 tons of flowers of sulphur. By the use of the distillation process, the company believes that the cost of production and maintenance will be greatly reduced. The machinery to be installed for the use of this process is constructed almost entirely of silica and carborundum brick, in order to avoid the use of metal parts. The use of metal equipment is expensive, iron and steel being quickly corroded by sulphurous fumes and liquids. The Continental Engineering Co. of Chicago will have charge of all operation and construction. From May 1 to October 1 the general offices of the company will be in Chicago. After October 1 the permanent and main offices will be moved again to Salt Lake City. After May 1 Mr. Morrissey will spend most of his time at the Chicago offices of the company attending to the purchase of machinery and equipment. At present the company is operating at part capacity, producing about 15 tons of brimstone and 3 tons of refined sulphur.

Box Elder County.—The 44,000-volt power line, constructed by the Vipont Silver Mines Co. from Oakley, Idaho, to its property, a distance of 21 miles, has been completed at a cost of about \$80,000; electricity now furnishes power for the operations of the company's mill. By April 20 the company expects to finish the construction of the line from the mill to the mine, a distance of about 4200 ft. The building of this power line means a saving of money and trouble, for the problem of keeping a supply of fuel-oil on hand during the winter, when the roads are often impassable, has been a difficult one.

Eureka.—Total production of ore from the mines of the Tintic district decreased from 150 carloads to 135 carloads for the week ending April 8. Tintic Standard shipped 48 carloads; Chief Consolidated, 31; Dragon, 15; Iron King, 12; Iron Blossom, 9; Swansea, 5; Eureka Hills, 3; Grand Central, 3; Sunbeam, 2; Victoria, 2; Eagle and Blue Bell, 2; Alaska, 1; Bullion Beck, 1; Gemini, 1. The closing of

the copper smelter of the State has resulted in the suspension of activities at the Centennial Eureka and the Bullion Beck properties, both of which are owned by the U. S. Smelting, Refining & Mining Co. At the Grand Central Mining Co.'s property all work has been suspended, according to W. D. Loose, manager, because there is no market for the ores. Operations are being resumed at the Mammoth mine on a small scale; lessees will soon be working in the lower levels.

Park City.—Due to the fact that the American Smelting & Refining Co. has notified the Ontario Silver Mines Co. to cease shipments of ore to the Garfield smelter, no more ore will be shipped from the Ontario mine until a market can be secured for its output. Although no stopping is being done at the mine, the company is, nevertheless, carrying on development work. Suspension of production at the Ontario mine will mean a reduction in the tonnage shipped from Park City. For the week ending April 8 a total of 1489 tons was shipped, as compared with 1815 tons for the week preceding. Ore production for the week of April 8 follows: Judge Allied companies, 840 tons; Silver King Coalition, 1489 tons. In order to carry on the exploration of the Park City formation in the Three Kings Consolidated Mining Co.'s property an assessment of two cents per share has been levied. P. J. Mackintosh, the manager, reports that drifting is being carried on steadily on the beddings adjacent to fissures No. 1 and 4 with promising results. Dave Erickson, foreman, has been succeeded by Eph Adamson, of Park City.

Salt Lake City.—A representative gathering of Utah mining men was assured by Senator William H. King that he would do all in his power to obtain relief for domestic lead producers. There was little prospect, he said, for the inclusion of metals in the emergency tariff bill; if metals were included he would see that lead was among them. Although he did not believe that the proposed anti-dumping bill would do much for lead producers, he was certain that lead would be adequately protected by the permanent tariff law which, in the Senator's opinion, would be passed by Congress between the middle of July and the first of August. Regarding the Pittman bill, Senator King said that he thought that an unsuccessful effort might be made to repeal the act. The Senator was of the opinion that even if the repeal bill did pass the House of Representatives it would be defeated in the Senate.

WASHINGTON

Stevens County.—The Double Eagle Mining Co. is installing air-pipes in the 500-ft. shaft and is planning to install air-drills. The company is extending the adit of the mine 300 ft., which will bring the main adit up to 800 ft. The mine, situated on the same claim as the magnesite quarry leased to the American Refractories company, has already shipped some high-grade lead-silver ore.

BRITISH COLUMBIA

Ashcroft.—F. F. Bradbury, of Vancouver, has bonded the Independent group, near Spence's Bridge, from Peter Sawyer. The claims contain an orebody carrying gold, silver, and copper. About 1000 ft. of development has been done, including a 400-ft. tunnel.—The Pioneer mine, Cadwalader creek, Lillooet district, will be re-opened by A. H. Wallbridge. The mine has produced \$135,000 in gold, and last year was bonded for a time to the Mining Corporation of Canada, which, however, relinquished its option.

Nelson.—Owing to the continued unsatisfactory condition of the lead and zinc market, the Silversmith mine has been closed. The mill was closed last fall. Since then about 40 men have been employed constantly and a considerable body of ore has been developed.—The annual report of the Rambler-Cariboo Mining Co., which recently has been issued, states that the mine was closed for more than half of the year, first on account of water shortage and then of labor trouble. Some 4000 tons of ore was milled, and 220 tons

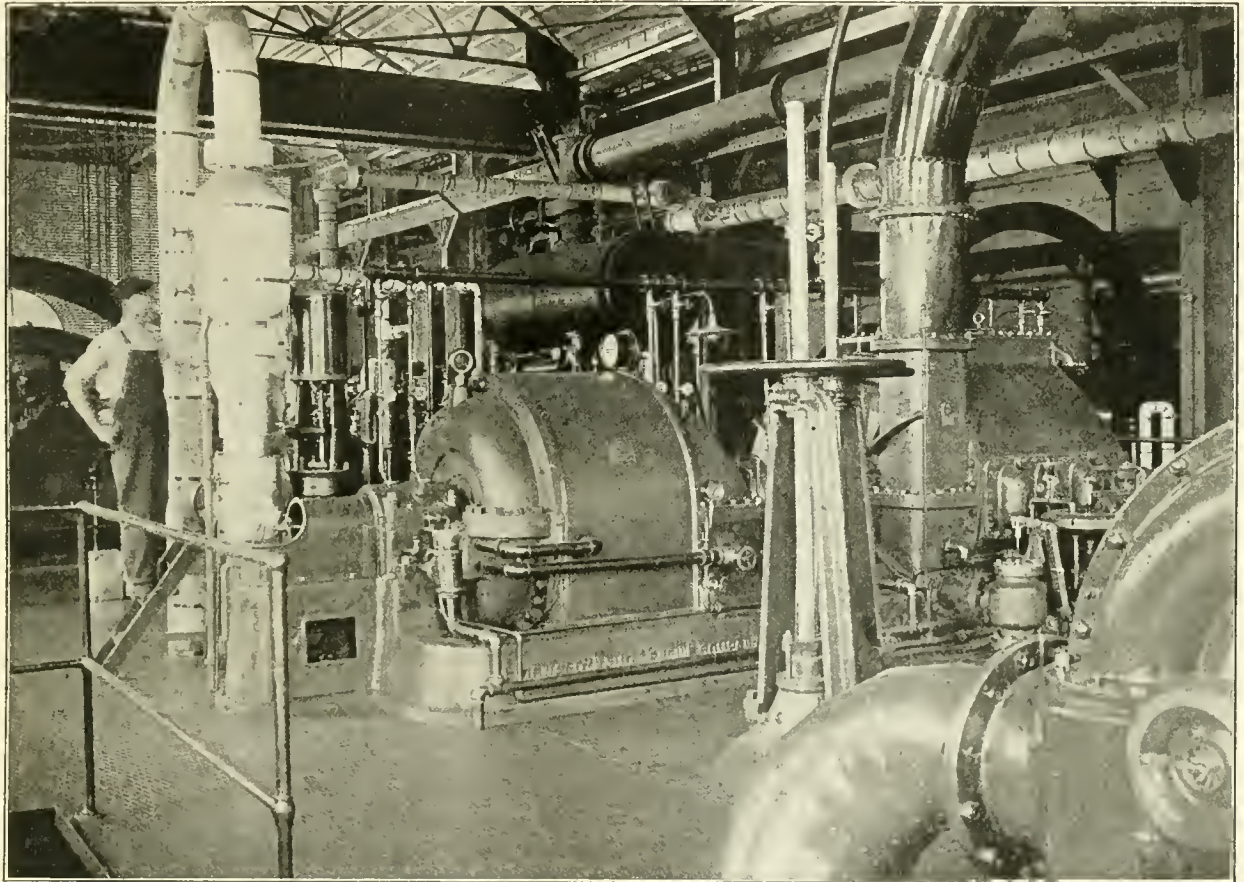
of lead and 250 tons of zinc concentrate produced. No shipping ore was found, but a quantity of mill ore was developed. The total receipts aggregated \$67,675, and expenditures, including \$25,000 paid on the Jennie claim, \$57,518, leaving a balance on hand of \$10,157. The assets of the company are valued at \$2,034,541, and liabilities on account of capital stock \$2,000,000, leaving a balance of \$34,541.

Prince Rupert.—Robert Clothier, resident engineer for the district, reports the finding of platinum associated with bornite and chalcopyrite in veinlets in diorite at the Swede group on Moresby island, one of the Queen Charlotte group.—Employees of the Algonican Development Co., who have been working at the Spider group during the winter, have started action against the company for back wages

73,236 tons in the first three months of last year, an increase of 35%. Of the total receipts this year, 99,970 tons was from the mines owned by the Consolidated Mining & Smelting Co. Total shipments for the quarter, with names of the mines and their location, were: 'Company' mines, 99,970; Gold Hill, Taghun, B. C., 33; Millie Mack, 12; Velvet, 63; Bell, 16; Horn Silver, 280; Sutherland & Thompson 15; Black Prince, 57; Blue Bell, 977; Gem, 11; L. T. Mine, 11; Nip and Tuck, 5; Lessees, Ainsworth, 112; Ruth, 21; North Star, 111; Paradise, 213 tons.

BRITISH GUIANA

A consular report says: Owing to the lack of demand in the United States for its product, the Demerara Bauxite Co.



Rateau-Battu-Smoot Turbo-Blower at the El Paso Smelter

aggregating some \$4000. Next to the Premier, the Algonican has been the largest employer of labor in this district. The manager went away last fall, leaving a small gang to continue work at the Spider throughout the winter, and it is these who now are bringing action. It is understood that the company is in financial difficulties. It had a good deal of bad luck last year, as almost immediately after it had completed repairs to the Portland Canal short line, the disastrous rains washed it out and the work done was entirely thrown away.—Roy Clothier and Alex McInnis have purchased a half interest in the Salvador group, Marmot River district, and will commence its development immediately. Three short tunnels have been driven on the property, each cutting a 2-ft. quartz vein that is said to average \$20 per ton in gold.—The Premier Gold Mining Co. sent another consignment of about 500 tons to the Tacoma smelter last week.

Trail.—Total receipts at the Trail smelter during the first three months of the year were 101,898 tons, compared with

has suspended all operations, thus throwing many American technical men and native laborers out of employment. This has caused a serious situation, which will doubtless be greatly aggravated by the close of operations of an American company. The output of both concerns has been shipped entirely to the United States. During January 1921, three cargoes, aggregating 8260 tons, valued at \$43,169, were shipped.

MANITOBA

Flin Flon.—It is reported from Prince Albert, Saskatchewan, that the Mining Corporation of Canada and English interests have completed a deal for the purchase of the Flin Flon copper property. No details are given.

MEXICO

El Tigre.—It is announced officially that the El Tigre Copper Co. will continue to produce ore as long as the smelter at El Paso continues to run. Should the plant there be shut-down the company will consider plans to ship ore to Chihuahua for reduction.

ONTARIO

Boston Creek.—The Miller Independence, which has for some time been the only company operating on any important scale at Boston Creek, has closed down. For several months work was carried on at the 500-ft. level to find the downward extension of 'D' vein, which yielded telluride of gold ore on the upper levels. Some promising veins were found, but nothing like the ore carried by the 'D' vein in the original shaft.

Cobalt.—The Nipissing during March mined ore of an estimated net value of \$156,775, and shipped bullion and custom ores of an estimated net value of \$346,584.—Since the recent discovery of high-grade ore at depth on the Chambers-Ferland, near the Nipissing boundary, a considerable quantity has been mined. It is officially stated that a shipment of seven tons containing a total of about 18,000 oz. has been made; the total so far taken out amounts to nearly double that figure.—The Kerr Lake has exercised its option on the Hargraves property adjoining its mine, which it has been developing through its underground workings. The purchase price is about \$17,000, which will pay off the indebtedness of the Hargraves but leave little for distribution among shareholders.

The Conlagas mine has established a new record in Cobalt by carrying on profitable operations on ore containing an average of 8 oz. of silver to the ton, and with the price of silver under 60 cents per ounce. Average wages to the miners amount to \$4 per day; the company pays \$50 per horse-power per year for electric energy.—Alterations are being made in the reduction plant of the Mining Corporation. These changes will be completed within the next three weeks, and increase the capacity of the plant by 50%. Officials believe it may be possible to resume work some time within the next month. The Kerr Lake mine will be unable to resume production under the present conditions and unless the price of silver should advance to 75 cents per ounce, or more.

Kirkland Lake.—A new ore-shoot has been discovered and opened up on the 700-ft. level of the Kirkland Lake mine. The same deposit has been reached on the 600-ft. level. The management is endeavoring to get a large amount of development and exploration done ahead of what will be needed for mill requirements, which it was unable to accomplish when handicapped by power and labor shortage. Most of the ore so far milled has come from development faces with a large mixture of lean rock, and it is hoped now to secure a steady supply of ore of even grade.—The American interests controlling Kirkland Townsite, lying south of the Wright-Hargreaves property, are arranging for its development on an extensive scale.

Porcupine.—Last week full power was available and the Hollinger, Dome, and McIntyre properties were enabled greatly to increase their output. The Hollinger treated 3300 tons of ore in one day. In order to bring operations up to capacity the company has placed orders for 30 more machines for underground work and will largely increase its working forces. Many miners are coming into the camp and labor is plentiful and efficient. A great revival of productive activity is setting in.—At the North Crown, rich ore has been found in the south section of the Porcupine Crown main vein. A drift on the 500-ft. level discloses ore reported to run \$20 per ton across the face of the drift.—The McIntyre is speeding up work; the mill will soon be brought up to full capacity of 600 tons daily which it is planned to increase to 1000 tons. The underground workings are being placed in condition to provide an adequate supply of ore at this rate.—The Premier Langmuir barite mine will be placed on a producing basis during the summer. The extent of the deposit is estimated at about 150,000 tons; the property possesses equipment and camp buildings in good condition.

PERSONAL

The Editor invites members of the profession to send particulars of their work and appointments. The information is interesting to our readers.

Dorsey Hager is at Los Angeles.

C. E. Minor is at El Paso, Texas.

Joseph Erlington is at Vancouver.

L. F. S. Holland is at Hollywood, California.

Howard D. Smith has returned to New York.

Letson Balliet has been to Silver City, Nevada.

Charles Janin has returned from British Columbia.

H. E. Wheeler, of St. Louis, was in New York recently.

W. W. Wishon has gone to Vancouver for two months.

G. H. Carnahan has returned to New York from Mexico.

F. C. Brown has moved from Quartzburg to Boise, Idaho.

Balliet R. Robbins, formerly of Fierro, New Mexico, is at Seattle.

Fred B. Church has moved from Los Angeles to Pioche, Nevada.

S. Ricker has moved from The Pas, Manitoba, to Berkeley, California.

James W. Nell is now with the Union Construction Co., of San Francisco.

M. R. Valentine is now with the Cerro Gordo Mines Co. at Keeler, California.

William Macdonald has moved from Tyrone, New Mexico, to Yerington, Nevada.

Paul Lincoln, manager of the Noble Five mine at Sandon, British Columbia, is here.

Frank M. Leland is at Naples, Italy, on a European pleasure trip with Mrs. Leland.

Douglas Lay succeeds Paul S. Couldrey as manager of the Le Roi No. 2 at Vancouver.

Ray L. Barber has returned to San Francisco from the Salmon River district of Idaho.

A. W. Newberry has returned to New York from Nicaragua after an absence of four months.

H. Foster Bain has been nominated by the President as Director of the U. S. Bureau of Mines.

Samuel H. Dolbear has gone to New York, where he expects to open an office as consulting engineer.

Curtis Alexander has moved from San Luis Potosi, Mexico, to Spring Valley, San Diego county, California.

R. B. Crowell, manager of the Big Chief mine at Middletown, Lake county, California, is at Berkeley.

Carl O. Lindberg has returned to Los Angeles after an absence of six months in Peru, Bolivia, and Chile.

Herbert C. Hoover has resigned as chairman of the American Engineering Council of the Federated American Engineering Societies.

H. W. Edmondson is in New York, having returned from an examination of the Rio Plata mine, near Guazapares, Chihuahua, Mexico.

E. A. Manderfield, mine superintendent for the Cia. de Minerales y Metales, at Cerralvo, Nuevo Leon, Mexico, is at Houghton, Michigan.

Charles W. Fears, formerly mine superintendent for the A. S. & R. Co. at Angangueo, in Michoacan, is now with the Amparo Mining Co. at Etzanlan, in Jalisco, Mexico.

George L. Porter has resigned from the presidency of the Afterthought Copper Co. at Ingot, California, and has moved to Union City, Tennessee, where he will look after some oil interests in Kentucky and Oklahoma, until mining conditions improve.

THE METAL MARKET



METAL PRICES

San Francisco, April 19

Aluminum-dust, cents per pound.....	75
Antimony, cents per pound.....	7.50
Copper, electrolytic, cents per pound.....	13.00
Lead, pig, cents per pound.....	4.50—5.50
Platinum, pure, per ounce.....	\$75
Platinum, 10% iridium, per ounce.....	\$105
Quicksilver, per flask of 75 lb.....	\$45
Spelter, cents per pound.....	7.50
Zinc-dust, cents per pound.....	12.50—15.00

EASTERN METAL MARKET

(By wire from New York)

April 18.—Copper is slightly more active and steady. Lead is quiet and firm. Zinc is inactive and easy.

SILVER

Below are given official or ticker quotations for silver in the open market as distinguished from the fixed price obtainable for metal produced, smelted, and refined exclusively within the United States. Under the terms of the Pittman Act such silver will be purchased by the United States Mint at \$1 per ounce, subject to certain small charges which vary slightly but amount to approximately three-eighths of one cent. The equivalent of dollar silver (1000 fine) in British currency is 46.05 pence per ounce (925 fine), calculated at the normal rate of exchange.

Date	New York	London	Average week ending	Cents	Pence
Apr. 12.....	62.87	36.50	Mch. 7.....	54.18	31.52
" 13.....	59.87	34.87	" 14.....	55.12	32.04
" 14.....	58.75	34.12	" 21.....	56.69	33.00
" 15.....	58.50	33.75	" 28.....	57.69	33.45
" 16.....	59.87	34.50	Apr. 4.....	56.92	32.98
" 17 Sunday.....			" 11.....	58.00	33.54
" 18.....	61.25	35.37	" 18.....	60.18	34.83
Monthly averages					
Jan.	1919 121.12	1920 132.77	1921 65.95	July	106.36 92.04
Feb.	101.12	131.27	59.55	Aug.	111.35 96.23
Mch.	101.12	125.70	56.08	Sept.	113.92 93.66
Apr.	101.12	119.56	....	Oct.	119.10 83.48
May	107.23	102.69	....	Nov.	127.57 77.73
June	110.50	90.84	....	Dec.	131.92 64.78

COPPER

Prices of electrolytic, in cents per pound.

Date	New York	London	Average week ending	Cents	Pence
Apr. 12.....	12.50	12.50	Mch. 7.....	12.43	12.16
" 13.....	12.50	12.50	" 14.....	12.16	11.87
" 14.....	12.50	12.50	" 21.....	12.15	12.15
" 15.....	12.50	12.50	" 28.....	12.68	12.50
" 16.....	12.50	12.50	Apr. 4.....	12.50	12.50
" 17 Sunday.....			" 11.....	12.50	12.50
" 18.....	12.50	12.50	" 18.....	12.50	12.50
Monthly averages					
Jan.	1919 20.43	1920 19.25	1921 12.94	July	20.82 19.00
Feb.	17.34	19.05	12.84	Aug.	22.51 19.00
Mch.	15.05	18.49	12.20	Sept.	22.10 18.75
Apr.	15.23	19.23	....	Oct.	21.66 16.53
May	15.91	19.05	....	Nov.	20.45 14.63
June	17.53	19.00	....	Dec.	18.55 13.18

LEAD

Lead is quoted in cents per pound, New York delivery.

Date	New York	London	Average week ending	Cents	Pence
Apr. 12.....	4.30	4.30	Mch. 7.....	4.06	4.04
" 13.....	4.30	4.30	" 14.....	4.04	4.00
" 14.....	4.30	4.30	" 21.....	4.00	4.00
" 15.....	4.30	4.30	" 28.....	4.00	4.39
" 16.....	4.30	4.30	Apr. 4.....	4.39	4.25
" 17 Sunday.....			" 11.....	4.25	4.30
" 18.....	4.30	4.30	" 18.....	4.30	4.30
Monthly averages					
Jan.	1919 5.60	1920 8.65	1921 4.96	July	5.53 8.63
Feb.	5.13	8.88	4.54	Aug.	5.78 9.03
Mch.	5.24	9.22	4.06	Sept.	6.02 8.08
Apr.	5.05	8.78	....	Oct.	6.40 7.28
May	5.04	8.55	....	Nov.	6.76 6.37
June	5.32	8.43	....	Dec.	7.12 4.76

ZINC

Zinc is quoted as spelter, standard Western brands, New York delivery, in cents per pound.

Date	New York	London	Average week ending	Cents	Pence
Apr. 12.....	5.15	5.15	Mch. 7.....	5.10	5.25
" 13.....	5.12	5.12	" 14.....	5.25	5.25
" 14.....	5.12	5.12	" 21.....	5.25	5.20
" 15.....	5.15	5.15	" 28.....	5.20	5.15
" 16.....	5.15	5.15	Apr. 4.....	5.15	5.15
" 17 Sunday.....			" 11.....	5.15	5.14
" 18.....	5.15	5.15	" 18.....	5.14	5.14

Monthly averages

Date	1919	1920	1921	Date	1919	1920	1921
Jan.	7.44	9.56	5.86	July	7.78	8.18	....
Feb.	6.71	9.15	5.34	Aug.	7.81	8.31	....
Mch.	6.53	8.93	5.19	Sept.	7.57	7.84	....
Apr.	6.49	8.76	....	Oct.	7.82	7.50	....
May	6.43	8.07	....	Nov.	8.12	6.78	....
June	6.91	7.92	....	Dec.	8.69	6.03	....

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, according to quantity. Prices, in dollars per flask of 75 pounds.

Date	1919	1920	1921	Date	1919	1920	1921
Mch. 22.....	45.00	45.00	45.00	Apr. 5.....	45.00	45.00	45.00
" 29.....	46.00	46.00	46.00	" 12.....	45.00	45.00	45.00
				" 19.....	45.00	45.00	45.00

Monthly averages

Date	1919	1920	1921	Date	1919	1920	1921
Jan.	103.75	89.00	50.00	July	100.00	88.00	....
Feb.	90.00	81.00	48.75	Aug.	103.00	85.00	....
Mch.	72.80	87.00	45.88	Sept.	102.60	75.00	....
Apr.	73.12	100.00	....	Oct.	86.00	71.00	....
May	84.80	87.00	....	Nov.	78.00	56.00	....
June	94.40	85.00	....	Dec.	95.00	52.50	....

BITUMINOUS COAL

The National Coal Association, in a pamphlet recently issued, says: Sifted down, the underlying problem of the bituminous-coal industry is that of railroad transportation. There is nothing vague or theoretical about it; just a practical problem of moving the coal from the mines. If the mines have the cars as they are needed the public will have its coal. And when there is an uninterrupted flow of coal, prices always will regulate themselves and always to the advantage of the consumer. When the transportation systems break down, for any cause whatever, and a shortage of cars exists at the mines, the whole scheme of supply is thrown out of joint and the nation faces a coal shortage.

Aside from the transportation feature, the soft-coal industry, it is true, has at times perplexing labor difficulties involving periodical tie-ups of mines. But, except for an unusual walkout, such as that of the miners in the winter of 1919-1920, strikes usually are confined, at any one time, to one or two fields. While seriously affecting the individual output of the mines involved, sporadic strikes do not, as a rule, curtail the aggregate yearly output of the mines as a whole, so as to threaten a nation-wide coal stringency. So transportation looms up, beyond all else, as the outstanding problem of the industry.

What makes the situation a difficult one from the viewpoint of the railroads is the solid fact that there is a material deficiency of cars in which to haul coal. This deficiency, as calculated by Daniel Willard, chairman of the Railway Executives Association last fall, runs to some 40,000 cars, with an aggregate carrying capacity of 2,000,000 tons on each haul.

With the car equipment now available the carriers must spread the haulage of coal over the entire year or, failing that, attempt to handle the major output of the mines in the period of greatest demand—the fall and winter months. How to keep coal moving to the public, so that the railroad systems do not become clogged when there is abnormal demand is the vexing problem that confronts the soft-coal industry no less than the railroads. And in the working out of this problem the public plays an essential part. Fairly even distribution of coal the year round in order advantageously to utilize the limited car equipment at hand is the practical way out of the difficulty. To bring this about, fore-sighted co-operation is needed on the part of the consumer—the large industrial user as well as the household—in arranging for his supply of coal in the off-season, the early spring and summer months.

How thoroughly the lack of sufficient transportation affected the soft-coal problem in 1920 and acted as the prime factor in limiting the output of the mines was clearly revealed in the Congressional inquiry. Of the actuality and the severity of the coal shortage of 1920, brought on by the lack of cars, there was ample evidence before the Senate investigators.

How transportation deficiency raises the cost of coal is graphically shown by charts embodying data assembled by the United States Fuel Administration. In figures the story is this:

When the car supply falls below normal by	The cost of coal rises above normal by
20%	12.0%
30	19.5
40	29.0
50	40.5
60	54.5
70	74.0
80	98.0

Applying the data given in this table to any period of car-shortage the advance in production cost in dollars and cents, attributable to lack of cars, may readily be estimated. A shortage of 50% in car-supply, such as obtained with most of the soft-coal mines in the spring of 1920, would involve a rise of from 70c. to \$1 per ton, and more, on the production cost alone, varying with the different mining fields.

MONEY AND EXCHANGE

Foreign quotations on April 19 are as follows:			
Sterling, dollars:	Cable	3.92 1/2	
	Demand	3.93	
Francs, cents:	Cable	7.24 1/2	
	Demand	7.26	
Lire, cents:	Demand	4.84	
Marks, cents		1.57	

Eastern Metal Market

New York, April 13.

Conditions are practically unchanged. There is no improvement in demand and no special weakness in prices.

The copper market is entirely stagnant but prices remain firm.

Buying of tin is light and spasmodic, with prices steady and largely nominal.

Lead continues the strongest of the markets but actual buying, while heavier than in the other metals, is not large in volume.

Zinc continues neglected with buying small and the price tendency soft.

IRON AND STEEL

The feature of the week was the announcement made on Tuesday afternoon, April 12, by the Steel Corporation, of a general reduction in prices. 'The Iron Age' says:

Steel Corporation prices and those of a number of independent steel companies have become identical on some products and in close relation on others, as the result of several interesting developments of the past few days. The new turn has caused more stir than the steel market has known in months, and its effect on the volume of business is being widely canvassed. Last week several independent steel manufacturers announced an advance of \$2 per ton in steel bars, and of \$2 to \$4 per ton in plates and structural shapes. On Tuesday afternoon, April 12, the Steel Corporation made public a list of reductions in its prices, effective on the following day, which brought bars down from 2.35c. to 2.10c., Pittsburgh, and plates and shapes from 2.65c. and 2.45c. to 2.20c. The Steel Corporation also reduced billets from \$38.50 to \$37; sheet bars from \$42 to \$39; wire rods from \$52 to \$48; and tin plates from \$7 to \$6.35 per box, or \$15 per net ton.

Operations at steel works in March were at the smallest rate on record, in proportion to capacity, and indications already point to a larger output in April. Uncertainty as to the Steel Corporation's price policy having now been removed for a time at least, freer specifications are looked for. This week the average of Steel Corporation and independent operation is probably 35%.

COPPER

Demand for copper has gone from bad to worse, actual inquiry being hard to find. Conditions are pronounced by a leading seller as being the most stagnant of any period in the history of the business. There is also pointed out the fact that there are about 700,000,000 lb. of refined copper in the hands of American sellers and producers, representing at least \$80,000,000, only half of which has been financed. Prices remain firm and unchanged at 12.75c., delivered, for April, and 13c. for second quarter, which means 12.50c. and 12.75c., New York, respectively, for electrolytic copper. Lake is nominal at 12.75c., New York, or 13c., delivered, for early delivery.

TIN

Business is confined to small sales, with consumers buying a little each day. The labor disturbance in England is having its effect on the market, but the prospect of some settlement yesterday, Monday, made for a stronger market over there than a week ago. Spot standard was quoted yesterday at £161 10s., future standard at £165, and spot Straits at £169 10s., all of which are about £9 per ton above rates a week ago. New York prices for spot Straits have been steady between 29 and 30c., New York, with the quotation yesterday at 30c., New York. There has been very little business here as a whole, especially yesterday and Monday. On the New York Metal Exchange early last week 25 tons of Straits tin, February-March shipment, was sold

at 29.25c. and 25 tons of May-June at 29.50c. Conditions in London have worked against any business here or there. Arrivals thus far this month have been light, at 295 tons, with only 715 tons reported afloat. The exportation of 200 tons to Rotterdam is noted.

LEAD

There is some divergence in prices at which the small volume of business is being done. The leading interest is taking some orders at its established quotation of 4.25c., New York and St. Louis; other business is reported taken by independents at as high as 4.50c., New York, or 4.25c., St. Louis. There are really two market levels, those unable to buy from the leading producer being obliged to pay as high as 4.50c., New York, in the outside market. The range therefore is from 4.25c. to 4.50c., or an average of about 4.37½ to 4.40c., New York. The outside market is quotable therefore at about 4.40c., New York. Taken in the aggregate the volume of business is small, however, but this market is the strongest of them all. There has just reached New York 2000 tons of Spanish lead for sale in this market when prices warrant. Present expense of importation is above domestic prices.

ZINC

Small lots of prime Western zinc for early delivery are being sold now and then, and constitute the present demand, which shows no improvement. Quotations are nominally unchanged at 4.65c., St. Louis, or 5.15c., New York, for the domestic metal, with odd lots of imported zinc, either re-shipment metal or of German origin, offered at around 5c., seaboard. It is not unlikely that desirable business might bring a concession from 4.65c., St. Louis, as the tone of the market is soft.

ANTIMONY

Demand is insignificant and quotations are nominally unchanged at 5.12½c., New York, duty paid, for wholesale lots for early delivery.

ALUMINUM

Virgin metal, 98 to 99% pure, is quoted by the leading producer at 28c. f.o.b. plant, for wholesale lots for early delivery; the same brand is offered by other sellers at 23 to 23.50c., New York.

ORES

Tungsten: The market has developed no change during the week. There is a fair amount of inquiry from consumers, and prices are firm at \$3 to \$3.25 per unit for the cheaper grades, with the better ones correspondingly higher. Ferro-tungsten is unchanged at 58c. per pound of contained metal in lump form, guaranteed as to quality.

Molybdenum: Quotations are nominal in a dull market at 50c. per pound of MoS₂ in regular concentrate.

Manganese: There have been no transactions, though one of some volume is pending. Quotations for high-grade ore are nominal at 25 to 30c. per unit, seaboard.

Manganese-Iron Alloys: A few small lots of ferro-manganese has changed hands at \$90, delivered, for the domestic alloy. A sale of 50 tons is reported at \$93, delivered. The British price continues nominal at \$100, seaboard. There is a fair inquiry for spiegeleisen, for which \$30 to \$36, furnace, is asked, depending on the seller.

Production of both of these alloys in March was high, considering conditions. The blast-furnace reports of 'The Iron Age' show the March output of ferro-manganese to have been 20,401 gross tons, and that of spiegeleisen 20,893 tons, both the largest for any month this year and even larger than a year ago when the pig-iron output was twice as much as last month.

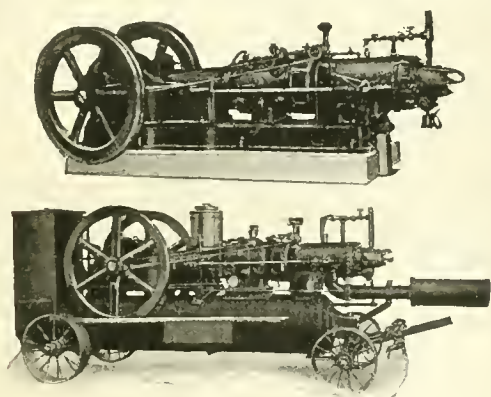
INDUSTRIAL PROGRESS

INFORMATION FURNISHED BY MANUFACTURERS

'CHICAGO PNEUMATIC' FUEL-OIL-ENGINE AIR-COMPRESSORS

Bulletin 607, recently issued by the Chicago Pneumatic Tool Co., describes the air-compressors illustrated herewith. They feature an interesting improvement in design, consisting of a removable cylinder-head which contains the combustion-chamber. By this construction combustion is effected in the cylinder-head instead of in the cylinder proper, thus securing more complete combustion with attendant higher economy of fuel and lubricant. Another advantage, it is said, consists of the almost complete elimination of carbon formation and the confining of such carbon as does deposit after lengthy service, to an area readily accessible for easy cleaning. This feature is also embodied in the Giant semi-diesel fuel-oil engines manufactured by the company.

Air-compressors of this design are designated Class N-SO2,



Fuel-Oil Engine Air-Compressors

and are described as being of the horizontal, straight-line, direct-connected type, with power-cylinder and air-cylinder in tandem on a common piston-rod, separated by a tandem piece which permits access to the stuffing-boxes of both cylinders. The power-cylinder is described as being of the valveless, two-stroke cycle, low-compression type, while the air-cylinder is described as being of the double-acting type fitted with Simplate flat-disc inlet and discharge valves.

The manufacturer claims a higher mechanical efficiency and a lower fuel-consumption per unit of air delivered than is possible in any other combination of engine and compressor, owing to the simplicity of the air-end of the compressor which has no valves, cams, cam-shafts, or electrical firing devices, and owing to the absence of belts, gears, or other forms of transmission.

Where fuel is plentiful and easily procurable, the oil-engine compressor, it is stated, is the most economical form of power for prospectors and contractors.

Portable tank-mounted types are built in capacities of 144 and 212 cu. ft. of air per minute. Capacities of stationary types range from 144 to 658 cu. ft. of air per minute. The latter type has the advantage of being flexible and is frequently used in batteries in plants where additional power is required from time to time.

EXPANSION BY UNITED FILTERS CORPORATION

An interesting development in the filter-manufacturing industry is the acquisition by the United Filters Corporation of a property at Hazleton, Pa., which was formerly owned by the Benjamin Iron & Steel Co. The property, when originally taken over several months ago, included a modern and thoroughly equipped foundry and a large machine-shop. Twelve acres of ground assures sufficient room for future expansion. Sidings run directly into the foundry and machine-shop, thus making it possible by the aid of modern cranes to load the heaviest machinery directly onto railroad cars.

During the past five months construction work has been undertaken and the property now includes a modern office building, a machine-shop with approximately 25,000 sq. ft. of floor-space, and an up-to-date foundry with a capacity of 25 tons of gray iron castings per day. It is interesting to compare the company's present facilities with their small manufacturing establishment of 1916 which consisted merely of a filter-leaf manufacturing plant, requiring the second floor of a small building in Jersey City.

Since the first of the year the company has transferred all of its manufacturing facilities from Belleville, New Jersey. A quantity of new machinery has been added in the shop which is provided with modern tools for handling both small and large work. Even the largest of the Sweetland units weighing over 10 tons are handled as readily as the laboratory units weighing less than 150 lb. The filter-press plates and frames are machined on modern highly developed equipment that reduces the labor cost and ensures the true-ness of the parallel finished surfaces. Here it is planned to build most of the company's products, including the American filters as well as the United filter-presses, and the Sweetland filters.

The demand for its equipment so widely used in the cane and beet-sugar districts, the chemical, mining, and metallurgical industries, is responsible for the corporation's move to concentrate all of its manufacturing at one point.

It has been the constant aim of the company to develop and build labor-saving equipment which eliminates high maintenance charges and loss of products in manufacture. The main office and testing laboratory of the company have been transferred to Hazleton. The company still maintains sales offices in New York, Chicago, and Salt Lake City with additional representatives in San Francisco, Los Angeles, and Europe.

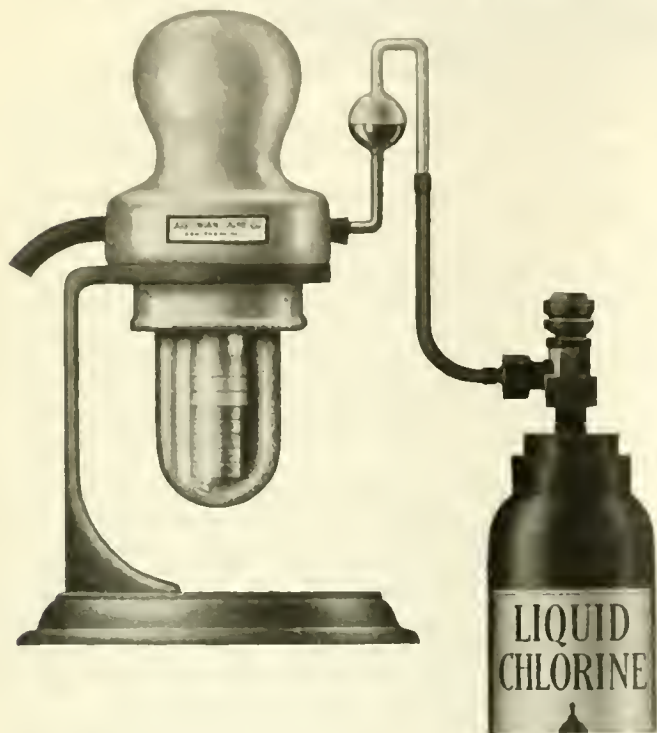
'LIQUID CHLORINE'

The use of 'liquid chlorine' is developing rapidly. The fact that rebellious ores are now successfully treated by means of 'liquid chlorine' without roasting, together with the cheapness of production of 'liquid chlorine' and the high cost of cyaniding will undoubtedly bring back the old chlorination process on a larger scale than ever. One of the greatest drawbacks met by metallurgical engineers and chemists in research work has been in the control-device for handling the chlorine under pressure from the cylinder or container.

Heretofore the apparatus for controlling chlorine has been

made of silver with intricate valves, gauges, and many other parts that are a constant source of trouble and expense, the high cost being in many cases prohibitive. The great demand for 'liquid chlorine' has induced the Justinaire Co. to introduce the latest and most simple control-device on the market.

The apparatus herein illustrated is made entirely of por-



celain and glass; it cannot get out of order, has sight feed, and delivers chlorine at low pressure from a high-pressure cylinder, in either a dry or damp state, at a minimum rate of 0.001 lb. per minute. The company is now prepared to express compressed 'liquid chlorine' in 10 to 100-lb. steel cylinders. The ease with which chlorine can now be handled, together with the low cost of the control-apparatus, will be of great benefit to those engaged in research work in connection with the chlorination of ores.

COMMERCIAL PARAGRAPHS

The Holt Manufacturing Co., of Peoria, Illinois, has retained the services of the firm of Erwin, Wasey & Co., of Chicago, to act in the capacity of Advertising Counsel.

Robert C. Weller has been appointed general sales manager for The Lakewood Engineering Co. with headquarters at Cleveland. Mr. Weller is in full charge of sales work. Carlton R. Dodge has been appointed Western sales manager with headquarters at 1215 Lumber Exchange Bldg., Chicago.

'Modern Road Building and Maintenance', published by the Hercules Powder Co., is a valuable new booklet just off the press. This book has been prepared for the use of engineers, contractors, road officials, students, and all who are interested in the rational and economic solution of the many problems connected with our public roads and the traffic they are required to carry. The book was written by Andrew P. Anderson, highway engineer for the Bureau of Public Roads. It contains chapters on Planning the Road; Road Materials; Road Construction; Road Maintenance and Repair; and Use of Explosives.

Bulletin No. 41521A, superseding Bulletin No. 41521, issued by the General Electric Co., is entitled 'High Speed Induction Motors and Frequency Changers'. The use of the high-speed motor has been rendered feasible by the de-

velopment of the induction frequency changer. The cost of the device is nominal and its operation automatic, no special attendant being necessary. Belts are eliminated, thereby reducing the first cost, up-keep, and loss of production due to belt-slip. The bulletin goes into detailed descriptions of the installation of motors on various types of machines.

'Nordberg Diesel Engines' is the title of a new 28-page booklet, known as Bulletin No. 31, which is being distributed by the Nordberg Manufacturing Co., of Milwaukee. Both photographic and diagrammatic illustrations are used to show the three types, and the important features, of Nordberg diesel engines driving generators and air-compressors. The booklet gives considerable space to the fuel-oil situation, the requirements of a diesel engine, and the principle of the two-cycle engine. It then points out the distinct features of the Nordberg engine, describes the different types and parts, and gives information relative to fuel-consumption, speed-regulation, auxiliary equipment, cooling-water, and operation at high elevations.

'Lunkenhelmer' is a name that always suggests 'valves'; many engineers unconsciously think of the other when they hear either word. In 1862 Frederick Lunkenhelmer established a factory at Cincinnati, Ohio, for the manufacture of bronze specialties with the purpose in mind of making his product known, first of all, for its excellence. The remarkable growth of the enterprise that he founded bespeaks not only success in this endeavor but a similar success in establishing business relationships based on square dealing and service. The company is now constructing an immense new plant to house its departments of manufacture, testing, engineering and design, as well as the physical and chemical laboratories. The 58th catalogue, just issued, is the same valuable handbook of valves and other fittings that has been standard for years.

'Electric Hoists' is the title of a new bulletin, No. 1819, being distributed by Allis-Chalmers Manufacturing Co. with the object of giving information to engineers, mine managers, and those interested in hoisting equipment, to assist them in the selection of the type of hoist to meet their individual requirements. A few only of the many types and designs of electrically operated hoisting equipment furnished by this company are illustrated. No part of mine equipment is of greater importance than the hoist, as safety to life as well as output and cost of production depend upon it. Since no two hoisting problems are exactly alike, the selection of the proper equipment requires special engineering knowledge and experience.

Having acquired sole rights to manufacture and sell Ideal pump-governors, the Atlas Valve Co., of Newark, New Jersey, is now distributing its first bulletin describing this excellent governor—Bulletin No. 1-A, edition No. 1. The bulletin is unusually complete. It shows photographs of finished pump-governors, and cross-sectional drawings with all parts numbered; installation and operation are fully explained; it gives dimensions and it also contains prices. The purchaser can therefore order directly from the bulletin without preliminary correspondence. It includes descriptions of the Ideal pump-governor for turbine or reciprocating steam-driven pumps; for marine or stationary turbines; fire-pumps, lubricating-oil pumps, bilge pumps; fuel-oil pumps; a pump-governor equipped with an emergency control lever for saturated or superheated steam; and automatic shut-off pump-governor that automatically shuts down a pump in case of accident to the pump-discharge line; a relief valve for oil-pumps accepted by the United States Navy for use on Navy vessels suitable for light or heavy oil under high or low pressure; and a high-pressure hydraulic regulating-valve suitable for pressures from 500 to 1000 lb. per square inch. A copy of the bulletin will be mailed upon request.



T. A. RICKARD, . . . Editor

BREAKING of the ice on the Yukon is announced. The snow is melting rapidly and the winter trails are becoming impassable. An early opening of the summer season appears to be assured for Alaska and the North.

INTERNATIONAL friction is often obviated by a conference and an exchange of opinions. We are glad to note that Mr. Van. H. Manning goes to London in June to attend the meeting of the International Chamber of Commerce, at which the question of oil resources will be discussed, and, presumably, the rival efforts to obtain industrial control of them.

THE Panama Canal earned \$10,297,362 in tolls last year, of which \$4,724,494 was contributed by British shipping. Expenditure totaled \$7,443,272; the surplus was, therefore, nearly \$3,000,000. It is estimated that after July next there will be a yearly surplus of \$5,000,000, assuming a continuation of the present policy with regard to toll-rates. The plan to exempt American shipping would bear lightly, if at all, on the American taxpayer.

A GOOD suggestion is often spoiled by over-enthusiasm. Attention has been drawn to the logic in the proposal of a commodity sales-tax as a good means of raising additional revenue, provided the assessment were not so great as to prove a burden on those outside the scope of the Federal taxes. On the basis of 0.3%, an additional revenue of about \$500,000,000 would be obtained. The 1% tax now proposed by Senator Smoot is too high.

JAPAN is jealously guarding her gold reserve, which amounts to 76% of her liabilities. In addition, she has a gold credit in this country that amounts to \$250,000,000, which, if withdrawn, would embarrass her internal economics. It is said in some quarters that the maintenance of high prices in Japan is being caused by the embargo on gold exports from that country. To paraphrase a proverb: money, or the want of it, seems to be at the root of all trouble.

PROHIBITION has not harmed the mineral industry, as far as can be seen; but it is indirectly the cause of embarrassment to the medical profession. Corpses for

dissecting purposes are now almost unobtainable, and medical instructors are forced to use charts, instead, to an increasing extent. In addition to a lowering of the death-rate, prohibition is responsible for bringing prosperity to those who, under the conditions that prevailed a few years ago, would have been willing to part with the remains of their deceased relatives, for a consideration.

THE decline in the price of tin has dealt a severe blow to the Cornish mining industry; the last of the mines to struggle against adverse economic conditions suspended operations on February 12. Thus we see the cessation of mining in a part of the world that, if records were available, might show an almost uninterrupted output from prehistoric times. The tin mines in the West of England were worked under the Romans, Cornwall and Devon being known as the Cassiterides, or Tin Islands.

NEW YORK is to have yet another newspaper, a weekly, the 'Irish People'. It is to be the child of the Irish-American Labor League; its purpose is to promote the establishment of an Irish republic on the Soviet plan, and to advocate, through the influence of Labor in the United States, a boycott of everything English, even to the extent of paralyzing any of our home industries that supply England with raw products or manufactured articles. Truly we are a long-suffering people. When will a committee be formed to secure the relief of America from Irish propaganda?

A STRONG plea for the continuance of work in connection with the manufacture of synthetic nitrate products at Muscle Shoals and for the completion of the Wilson dam is contained in an article by Mr. Courtenay De Kalb that appears in the 'Manufacturers Record'. Mr. De Kalb sees a menace in the fact that the route between Chile and the United States must be kept free by the United States Navy in the event of war; at the cost of two battleships it is maintained that independence from Chile can be secured in the matter of a national supply of fixed nitrate. Mr. De Kalb states that as soon as Japan realizes that we are no longer vulnerable at a point where she can easily strike with her fleet, she herself will come into a more mollified mood, readier to listen to international counsel, and to co-operate in working out a rational *modus vivendi* in the Far East. The Muscle

Shoals dam is still in process of construction, but work will soon cease unless Congress makes an emergency appropriation for the continuance of the enterprise. About \$12,000,000 is needed to complete the project.

IN a report just issued, Mr. H. Foster Bain, Director of the U. S. Bureau of Mines, draws attention to the decrease in disastrous coal-mine explosions since the Bureau introduced the system of mine-rescue and first-aid training. In 1921 there were 8 major disasters in coal mines, causing 61 deaths, equivalent to an average of 2.7% of those killed from all causes. As against this record there was an average of 12 major disasters, causing an average of 360 deaths, in each of the three years 1911 to 1913. The number killed in those years averaged 35 per major disaster, or 14.2% of the total killed from all causes. In 1911 the fatal accidents averaged 4.71 per thousand; in 1919 the average was 3.23%. This indicates the progress made in safety methods.

RETENTION of proved practice is often a sound policy, in spite of the allurements of the up-to-date. The treatment plant of the Mysore Gold Mining Company, in India, has recently been overhauled and the flow-sheet re-arranged; not only has amalgamation been retained as the fundamental process for the recovery of the bulk of the gold, but successful efforts have been made to increase the yield from the plates. After an adequate amalgamation treatment, less than 25% of the gold is left in the tailing, and this material is of so low a grade that it can be treated by the cyanide process to leave a final residue that carries only five grains of gold per ton. The Mysore company is one of the few remaining gold-mining concerns that pay healthy dividends to their stockholders, an amount equivalent to 25% of the issued capital having been distributed since October 1, 1920.

THE interdependence of a number of industries is illustrated by an explanation, of recent causes and effects, in the annual report of the American Zinc, Lead & Smelting Company. The corporation owns, among other interests, the property of the American Zinc Company, of Tennessee, where the tailing from a concentrated zinc ore is sold, after preparation, as a fertilizer component. A considerable amount of the zinc produced appears on the market, ultimately, as the oxide, used largely as a filler for rubber goods. The collapse of the tire industry in the United States last year caused a sudden reduction in demand and a decrease in profits. Later in the year the drop in the value of agricultural products led to the curtailment of orders for fertilizer, and again the company was hit. It may be wise not to put all one's eggs in a single basket; but if the baskets are tied together, the result is much the same.

COPPER prices have shown no recovery since the cessation of production from the principal mines was announced nearly a month ago, but quotations have stiffened. Consumers are holding back, knowing that

there is a stock of about 700 million pounds available. Europe has shown an inclination to buy more American copper than at any time during the last twelve months; the principal purchasers are Japan, Germany, England, Sweden, and Denmark. It is estimated that when current stocks at mines and smelters have gone to market the total production in this country will be no more than 30 million pounds per month, as against an average of about 100 million pounds monthly during last year. The consumers have the best of it just now, but the producers will come to their own ere long; that is certain.

VARIOUS pleas for protective duties are being presented to Congress. For example, the miners of chrome ore are asking for the protection of an industry that proved itself of great national usefulness during the War. Our sympathies are with these miners and we shall not be sorry if they receive assistance in their competition with supplies from foreign countries. Most of us are free traders at heart except for commodities we ourselves produce. That is why Californians ask for a tariff on lemons, the Nevadans on tungsten, the Texans on cotton, the Ohioans on wool, and the Vermonters on pins. As General Hancock said long ago, the tariff is a local question, and he might have called it a selfish question. The old-fashioned Republican might use the words of an old hymn:

"Awake, asleep, at home, abroad,
I am protected still, by God."

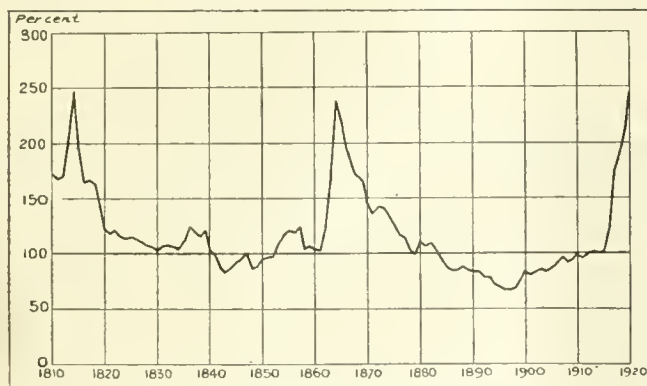
In order to express the newer meaning, we have inserted a comma after 'still'.

THE gold production of the Transvaal for February represents the smallest output for any corresponding month of the year since 1908. The yield has shown a steady decline. In 1916 the January-February return was over 1½ million ounces; in the same two months of this year it was less than 1½ million ounces. A proportion of the decrease is said to be due to labor troubles, in which both white and black employees were concerned. A strike occurred at the Consolidated Langlaagte mines on February 7; it spread, and a settlement was not effected until February 18. The decline of production from known goldfields is worldwide. In this issue we publish a brief account of a little-known district in equatorial Africa, which is already producing gold at a steady rate. Further discoveries will doubtless be made in tropic countries, where difficult transport and dense vegetation have impeded prospecting and development, but from where a large proportion of our future supply of gold may ultimately be won.

GOVERNMENT officials, it is said, announced last week that the coining of silver dollars was to begin forthwith at the Denver mint "in an effort to replace for circulation over \$200,000,000 withdrawn during the World War and melted down for shipment to India". This was good news to the miner, but its authenticity

became questionable when it was stated also that "quantities of silver ore have been received at the Denver mint from Western mines during the past months". A mint receives bullion to be refined, not ore to be smelted. However, the chief statement about the coining of a large quantity of silver at Denver has been confirmed. Apropos of which it is interesting to note that on April 15 Great Britain paid the United States \$25,000,000 as the first installment of interest and principal on the special debt of \$122,000,000 incurred on account of the 208,000,000 ounces of silver obtained in 1917. Another installment of \$17,000,000 is due on May 15. The loan is to be repaid within the next three years. Congestion of goods still burdens the market of Bombay, Calcutta, and elsewhere in India. Until business improves in the Orient, the price of silver is unlikely to recover.

IN the 'Annalist', of April 11, Mr. Ralph G. Hurlin discusses the course of wholesale prices in the United States during the last hundred years and gives a graph showing that a peak of high prices was reached at the time of the War of 1812, during the Civil War, and during the World War, and that as a period of deflation followed the two previous wars, so also a weary period of deflation must follow the commercial exuberance of our



THE PEAK IN WHOLESALE PRICES

last war. "The three wars", he says, "mark the beginning and end of two complete economic cycles in this country." The first stage of deflation is rapid; then follows a slow decline in prices. After the two previous wars, however, the lack of Government control over our monetary system prevented any kind of rapid restoration to economic healthfulness, whereas today the incomparably strong financial position of our Government and the sagacious control it exercises, through the Federal Reserve system, over our monetary and trade conditions, justify the expectation that the present period of depression will be comparatively short.

BOOSTING is a pleasant pastime for the irresponsible, but our local press could serve San Francisco better by intelligent criticism of things that need to be mended than by unintelligent praise of this community, at the expense of other parts of our own State—what the ordinary reporter calls "small-town stuff". For example, it is stated in 'The Journal', the new and admirable

newspaper recently established in this city, that the firm of C. F. Braun & Co., manufacturing engineers, "has decided to withdraw completely from San Francisco in favor of Los Angeles" on account of "the failure of city officials to offer protection" from "the violence of thugs operating in behalf of the unions". The Braun company is working on the basis of an 'open shop'. At three different times its employees have been assaulted by "a group of well-known thugs", that is, we presume, ruffians known to the police, and on no occasion has the company been able "to bring about a just prosecution". Two foremen and a skilled workman have had to go to the hospital on account of personal assaults from "gangsters", one of whom was arrested but released on account of the fact that the man he attacked was able to defend himself, although much injured in the fight. The maintenance of the law and the establishment of order are more important to San Francisco than any amount of small-boy self-advertisement at the hands of a putrid press.

SPACE is gladly given in the present issue to our friend Mr. T. T. Read, who writes on the subject of the Institute's Transactions. He is critical of a recent editorial in the 'Press', and we like the attitude; but at the same time his letter calls for further comment. He objects to two statements we made: (1) that the Bureau of Mines has ample funds for the publication of reports, and (2) that the reports are distributed in such a way as to reach the public that wants them. Confirmation of the second conclusion is found toward the end of Mr. Read's letter, in which he says that last year the superintendent of documents sold Bureau of Mines publications to the value of \$14,000, of which the free editions had been exhausted. This would seem to indicate that they had reached the public that wants them. With regard to the sufficiency of the funds provided by the Government for the Bureau's publication activities, this would be largely a matter of opinion, depending, in no small measure, on the verdict as to suitability and value of the material that appears in print. Mr. Read explains that Bureau of Mines papers of ambitious length are sent to societies like the Institute for publication because they are too long for the average technical journal; but this is merely begging the point. The Institute may have, as he remarks, the facilities for printing lengthy papers, but the point that we emphasized was that the dues of members should not be employed for this purpose: papers and monographs should not be published at the expense of those members of a technical society who think them valueless, neither should engineers be obliged to pay for the printing of matter on subjects in which they have no interest. Such expense on the part of the Institute is only justified in connection with brief papers on live topics—papers that will elicit discussion and comment. If, as Mr. Read suggests, the Institute reciprocates to even a greater extent by using the Bureau of Mines as a medium of publication, then this is only another indication of gross mismanagement; it is news to us. At this stage, however, we would make our criticism constructive.

Lengthy articles and monographs should have a commercial, as well as a technical, value, otherwise there is no excuse for their appearance. Our great publishing houses are well equipped for the production of a standard type of booklet, bound or in paper covers, that would reflect credit alike to publisher and author; this could be produced for a comparatively small sum—the author, of course, foregoing royalty. The larger monographs should be able to depend on popular acceptance by the engineering public, which is only too willing to pay for what it wants, but which dislikes to pay for what it does not want. Book publishers would do well to study the question. A standard style for monographs would be acceptable; it would encourage the author to consider the reader, as well as the reader's pocket. After applying this test it would be found practicable to avoid the publication of a great deal of the exuberant matter that now appears in print; lengthy monographs would be condensed to pamphlets, and pamphlets to articles of reasonable length, and the articles in turn would thereby become acceptable for publication in the Transactions of the Institute.

Reporting a Convention

Every mining convention results in criticism of one kind or another. After the American Mining Congress held its meeting at Denver last November we discussed the lack of method for curbing excessive loquacity; the one held at Portland leads us to comment on the poor reporting of the proceedings in the local press. It is true, the delegates passed a resolution thanking the press for its performance, but this was merely a perfunctory compliment. In any event we venture to express our own opinion, for what it may be worth, that the newspapers of Portland reported the proceedings inefficiently, despite the fact that in the 'Oregonian' the city of Portland has the best daily paper on the Pacific Coast. The reason why the work is done unskilfully, if not stupidly, is because it is placed in the hands of reporters without any real training for their duties. They appear unable to use shorthand, they fail to reproduce the words used by the speakers, and they aggravate their blunders by placing their own hashed renderings between quotation marks. In one case, of which we are personally aware, a reporter wrote an entire paragraph out of his own head on a matter to which the speaker had not even referred; nor was it merely a misplacement of remarks made by another speaker on the same occasion, that is, it was not an accident, but an act of sheer irresponsibility. This was in the Oregon 'Journal'. The space given by the press to the convention was not inadequate, but the reporting was done by men who were ignorant of the subjects discussed, and careless in their presentation of the facts. As usual, some of the accounts were prepared without actual attendance at the sessions, as is proved by the fact that mention was made of papers that were not presented and of speakers who were not even in Portland. This is a failing only too common on the part of the daily press, and serves to suggest the lack of

sincerity of purpose marking the average reporter, whose work of reporting, on the whole, is devoid of intelligence; it is more like that of a small and irresponsible boy than that of an honest and keen-witted man. The usual product is a disgrace to journalism and suggests how little our so-called schools of journalism have been able to accomplish in the way of inculcating intellectual honesty or anything akin to it. Partly it is the fault, of course, of the editors, who feature the tawdry and the sensational. For example, the Associated Press sent out an extract from the address on 'Prospecting'; it is a significant fact that most of the headlines featured the comparatively inconsequential reference to the prospector's loss of his whisky; that one remark caught the attention of the editors of most of our newspapers and held it at the expense of anything more interesting that the speaker had discussed. It may not be gracious to look a gift horse in the mouth, but if journalism is to improve, it will improve only by reason of frank criticism and by strengthening the hands of those who are earnest in their work. The practical suggestion to be made in this connection is that our mining conventions should not only keep a record of their own meetings, as they do now, but they should also furnish the local press with a correct and coherent account of the proceedings, with an eye, of course, to its news value.

New Methods in Geology

Geology applied to mining, and more particularly the need of quantitative methods, is the subject of a scholarly article in this issue by Mr. Charles H. White, formerly Professor of Mining and Metallurgy at Harvard. Mr. White is now a resident of San Francisco and recently he and his associate, Mr. Augustus Locke, addressed the local section of the Institute on scientific methods of prospecting, eliciting an interesting discussion. Such interchange of ideas between geologists and engineers, or between economic geologists and mine managers, is of obvious usefulness to the profession and to the industry. As Mr. White says, there have been always two classes of contributors to knowledge. Theory and empiricism have corrected each other, the induction from facts has checked the exuberance of deduction from principles. The study of volcanoes has not made much progress since Paulet Serpe and John W. Judd put vulcanology on a scientific basis, and we agree with our contributor that a subject for fruitful investigation would be found in a study of the gases emitted from volcanoes. In Italy the steam from fumeroles is being used for the generation of power. Bore-holes from 300 to 500 feet deep, and from 12 to 20 inches in diameter, emit steam at a temperature ranging from 300° to 375°F. Three sets of condensing turbo-generators have been put in place, each of 3000 kilowatts and operated with superheated steam at 22½ pounds pressure, generated in tubular boilers of the marine type. This was done in 1917, at Volterra, in Tuscany; what progress has been made since then we do not know. At that time 15,000 horse-power had been developed. Assuredly it seems strange that mankind should ignore the

heat under the crust of the earth and not avail itself of that heat at the places where it escapes at the surface. Bore-holes and shafts have proved that there is a regular increase of heat in depth, the increment varying from 50 to 200 feet per degree Fahrenheit, so that at a depth of 10,000 feet the temperature of boiling water would be reached in many parts of the globe. How far a drill-hole could be driven without being stopped by the plasticity of the rock is a question, but it seems a safe prediction that the day is not distant when heat, and therefore power also, will be obtained by man from the interior of this planet. It seems foolish for him to dig coal at a depth of 5000 feet and hoist it laboriously to surface when he has the chance to tap an unlimited source of heat by making a hole not much more than twice as deep. To accomplish this feat would be a great performance in mining. Meanwhile we revert to Mr. White's study of outcrops and his practical observation that in the vicinity of copper deposits there is twice as much quartz in the orebearing ground as in the ground containing no ore. This is a valuable hint. The miner will be grateful to the geologist for such helpful suggestions. At one time the secondary origin of chalcocite seemed to have been proved; this was taken as a guide in estimating the continuity of a certain type of copper deposit; but primary chalcocite was found in other large orebodies, and many inferences that had been confidently accepted had to be put aside. Not much has been accomplished as yet by the geologist in the way of quantitative prospecting, although his elucidation of structural conditions has been of inestimable value to the miner in his exploratory work. Mr. White is modest in his valuation of the benefits arising from the application of geology to mining; it must be remembered that, apart from direct aid in finding ore, the study of ore deposits has sharpened the powers of observation of the mining engineer and has given him a light by which to steer his course underground. The application of the modern science of geology to the ancient art of mining is one of the most striking examples of industrial progress. The geologist need proffer no apology; he has more than made good.

Credulity and the Nitrate Deposits

In 1898 a well-known firm of London publishers brought out a new and entirely novel magazine, having for its motto: "Truth is stranger than fiction". An early issue contained the first installment of one of the most amazing stories of privation and adventure that has ever been published. The author, a Frenchman named Louis De Rougemont, described how he spent 28 or 30 years among the cannibals and aborigines of Australia, after having survived the wreck of a pearling lugger off the north-west coast. The story was arranged to be published in book form and was dedicated to the author's devoted wife, Yamba, a native 'gin', or black woman, of whom he told the most affecting tales of courage, devotion, and loyalty. Interest in De Rougemont became general, and the tale was translated into all the principal foreign languages. The details were verified as far as

possible by responsible geographers and were found to be in complete accord with the scanty information available concerning that part of the world; it was even said that the data obtained would prove of immense scientific value. Inquiries from a large number of interested parties elicited the information that De Rougemont was busy on the arrangement of material for scientific papers, and was posing for his portrait. In August 1898 he achieved his crowning triumph: he read two papers before the British Association for the Advancement of Science—often referred to by the more frivolous as the 'British Ass'—an amiable body of individuals of whom at least 1% were scientists. Much to the disappointment of the assembled savants and pseudo-savants he was unable, on account of the enfeebled condition resulting from the many years of hardship and exposure, to remain long enough to answer questions about his experiences. A few months later it was found that, although truth may be stranger than fiction, De Rougemont's tale was stranger than either; when dissected by the few real authorities that knew anything about the desolate regions of Australia, it failed 'to hold water'. It was said that his real wife, who had not heard from him for many years, 'gave the show away'; portraits and press notices were his undoing; she probably thought that there was a foundation of truth in the Yamba story anyway, so the adventurer's fall followed forthwith. De Rougemont was a fraud. To use an expressive slang: both the British Association and one of the most important of London publishing houses had been 'stung'. The travels of the adventurer had been exceedingly circumscribed; and the story had been written with the aid of what information was available in museums and libraries. The scheme was so successfully piloted that De Rougemont managed to evade all actions for fraud. The last heard of him was that he was appearing in vaudeville and demonstrating that it was entirely feasible to ride a turtle in the water and to steer the animal with one's toes.

The De Rougemont story was allowed to die a natural death. But the thirst of the British Association for the Advancement of Science for something that would startle the world could not be slaked by means of one or two De Rougemont papers. It sought the sensational, and it got it. At the same meeting of the same society the audience, agape for something new, listened to a prophecy from Sir William Crookes that the Chilean nitrate deposits were approaching exhaustion. In from 20 to 30 years the normal-grade reserves would be gone, and in 50 years we should be facing starvation unless we made appropriate overtures to the chemists. "Before we are in the grip of actual dearth," said Sir William, "the Chemist will step in and postpone the day of famine to so distant a period that we, and our sons and grandsons, may legitimately live without undue solicitude for the future." The world is, and will be, indebted to chemists for their achievements, but the prophecy about Chile should have been put in the same category as the De Rougemont tale. To the contrary, it received world-wide acceptance, because of the sponsor's standing as a chemist, as the discoverer of thallium, and as the inventor of

the Crookes tube, not as an authority on nitrate deposits. It is still reverberating. The U. S. Department of Agriculture now says that the beds will last only a few more years.

We are reminded of Carlyle, who in one of his essays quotes Antonius: "For who can change the opinion of the people?" He explains how rumors arise and spread. "It is singular," he says, "with what perfection of unanimity and quasi-religious conviction the stupidest absurdity can be received as an axiom of Euclid . . . no basis for the notion have they formed, yet everybody adopting it, everybody finding the whole world agree with him in it; and, in the universal repetition and reverberation, taking all contradiction of it as an insult, hardly to be borne with patience." For 23 years the Crookes prophecy has been used for propaganda purposes in favor of that national essential, an operating synthetic nitrate industry. In the meantime, Chile steadily increases production, without exhibiting the least signs of exhaustion. Germany, before the War, would have taken the double action she did with or without a knowledge of the Crookes prophecy. She sent capable engineers to Chile, she invested heavily in the Chilean nitrate industry, she imported large quantities of the natural product, and she increased the productiveness of her soil to about 225 bushels of wheat per acre. With efficient farming and cheapened harvesting she lived more economically, and was able to afford the best talent for the solution of the synthetic nitrate problem. Here in America one of our own Government bureaus tells us that there is practically no nitrate in Chile. We have little interest in the deposits; our Senators bewail the fact that 'perfidious Albion' helps to fix the price of the article she assists so materially in producing; our wheat crop per acre is less by half of what Germany's was before the War. The amount of fertilizer purchased to date this year for the cotton fields of Alabama, Georgia, Louisiana, and the Mississippi region amounts to less than one-third of what was ordered during the same period last year. If this attitude be maintained, what kind of crop will result? And how much more labor will be required per unit of yield? And what is wheat and cotton going to cost in the end? America has been scared from taking an interest in the Chilean industry, vast sums have been spent in fancy machinery and essential equipment for synthetic plants that have never operated on a working scale; and in justification for the present situation we are told that Germany can furnish all the synthetic nitrate we need at 3 cents per pound, fixed nitrogen content, which will sell in the United States at half the price the American farmer has been paying for the Chilean product. The facts are overlooked that we are in desperate need of fertilizer at a reasonable price, and that the high price paid in America for Chilean nitrate is due (1) to the circumstance that Chile possesses a monopoly of this valuable material; (2) to the lack of support from American capital; and (3) to the failure of more than a very few American engineers of high standing to interest themselves in the problems of caliche extraction and treatment. Such is the effect of the continuous reverber-

ation of twaddle. The Crookes prophecy is still being used as a means to stimulate an interest in the construction of synthetic plants, whereas no incentive should be necessary.

Authorities who have studied the matter estimate that the reserves of Chilean nitrate will last for 200 years, but it is doubtful whether this figure takes into account the vast tonnage of low-grade caliche and ripio that is available; and which will, in due time, be treated by adequate methods to yield a satisfactory extraction. The failure of the Crookes prophecy has not been due to the introduction of improved methods or to larger-scale operations. Success awaits those who have both the initiative and the capital. To those who require convincing proof of the exact amount of nitrate in the Chilean pampa it is suggested that they consider for a moment the cost of the investigation that would be necessary. Why should the Chilean government spend a million dollars in an attempt to disprove the vaporings of irresponsible and uninformed persons? Deposits in Chile are on a large scale. A casual inquiry as to the total ore-reserves of the Chuquicamata copper mine might well elicit an estimate, from one who knew the deposit, of a couple of billion tons or so. The figure is a staggering one, and the Chile Exploration Company would see no reason for verifying it by costly development; but these facts should offer no justification for the dissemination of foolish prophecies, predicting the early exhaustion of the mine. The ubiquity of nitrate over an immense area in Chile is patent to anyone who has taken the trouble to investigate first and talk afterward; but so long as the present political propaganda is countenanced, so long will a profitable field for technical and scientific achievement remain closed to American engineers. We learned recently that the Guggenheim Brothers are now taking an active interest in the industry. Although none of their staff has been associated with work on the nitrate pampa, it is obvious that the firm possesses the necessary capital to obtain what it requires, and so to make the venture a success. Its strategic position is extraordinarily favorable. With a power-plant at the coast, to which additions will probably be made in order to cope with the increased capacity of the Chuquicamata mine and plant, with an abundance of exhaust steam for evaporative purposes, and with the nitrate pampa lying between Toepilla and Chuquicamata, it is obvious that the two industries—copper mining and nitrate production—can be combined in a manner that, to judge from the success of the salt industry in the United States, offers great possibilities of financial return. When Chilean nitrate can be produced in quantity and cheaply, then can we begin to talk about a material reduction in the present high cost of living, by an emulation of Germany's action before the War—by producing and by buying all the nitrate needed to farm at maximum efficiency, and by developing the synthetic industry at the same time. The best way to ensure commercial success in the manufacture of synthetic nitrate is to absorb the natural product to as great an extent as possible. The nitrates and iodides in Chile refuse to disappear at the wishing of chemists and Bureau officials.



The Transactions of the Institute

The Editor:

Sir—The editorial on this subject, which appeared in your issue of March 26, is extremely interesting and with much of it I find myself in agreement. One sentence, however, I must vigorously dissent to because none of the three statements made in it appear to me to be correct. You say:

“The Federal Geological Survey and the Bureau of Mines each have ample funds for publishing their reports, and they distribute a large quantity in such a way as to reach the public that wants them; why should they use the Institute so freely for this purpose?”

I cannot, of course, attempt to speak for the Geological Survey, but the Bureau of Mines certainly has not ample funds for publishing its reports. The amount of money allotted to the Bureau of Mines annually for printing has not increased anything like the rate of the growth of the Bureau's work, even if the increase in publishing costs were not considered. When the increased cost of paper and printing is taken into account, we find ourselves in the position, that, although the Bureau was originally established to investigate and disseminate the results of its investigations, the appropriations for investigative work have increased year by year and the funds available for dissemination of the results of the investigations have not been increased in anything like the same proportion. When I came to the Bureau, I found that the accumulation of material awaiting publication was so great that it was only a matter of a short time before the Bureau would have on hand at the beginning of the fiscal year enough material ready for publication to exhaust its total printing fund for the whole year.

So much for the first clause: The second statement is that we distribute a large quantity in such a way as to reach the public that wants them. I cannot agree to this either because, while the Government has facilities for printing reports, it has no facilities for publishing them except through the courtesy of the technical press. As you know, it is our custom when a report is issued, to send out a brief review of it to the technical press and the editors are usually kind enough to reprint this so that the public becomes aware of the existence of such a report. We also send out our postcard notices to a large mailing list but, as you know, a man does not always know whether a report will be of interest to him simply by looking at its title. Furthermore, there are a great number of people who would be interested in these papers but who would not go to the trouble of writing for them.

In the old days, when the Institute used to publish papers in its monthly bulletin, I used to look over each one of them with more or less care. Since they have introduced the system of having you fill out a slip and ask for a paper, I have not asked for a single one. In other words, the Institute has ceased publishing its material and now only prints it. If an investigation made by the Bureau is of such a character that it ought to be made available to the greatest possible number, the best way to attain that end is to publish the material in a technical journal of large circulation, both because it is possible to get it out quicker in this way, and also because it comes before the eyes of more people than it is ever likely to, if published as a regular Bureau paper. Most of our investigations, however, are too long for a technical journal to print in full. This is why they are sent to learned societies like the Institute which have facilities for printing longer papers.

As regards the third clause: I must deny the statement that we use the American Institute of Mining and Metallurgical Engineers for the purpose of conserving our own printing funds. As a matter of fact, the Institute has used us for that purpose much more freely than we have used them. You may remember, a few years ago, the Institute had to print Prof. Christy's researches on electro-deposition of gold and silver; they were at a great loss as to how to handle it until they hit on the expedient of asking the Bureau of Mines to publish it for them. I think I can say without reservation, that whenever the Bureau of Mines has submitted a paper for publication by the Institute, it has either been because some committee chairman has urgently solicited the paper or because the investigation was still in progress and the author wished to make a preliminary presentation of his ideas and evoke discussion from his colleagues before writing the final paper which was to be published by the Bureau. Our bulletins are supposed to be monographic treatments of a subject and before the publication of a bulletin, the author is supposed to have the subject completely in hand so that it will not require later revision in the light of further knowledge.

As a matter of fact, a number of our investigators have recently stated to me that they are unwilling to contribute any further papers to the Institute on the ground that the editorial revision that they receive is frequently detrimental to the paper and that the amount of discussion which is evoked by presentation at an ordinary meeting, where a dozen different things are scheduled for the same time, is too slight to compensate the author for the effort required in preparing a paper. I must say that I

sympathize with them because I have attended many meetings at which carefully prepared papers have been given but the scantiest attention by an audience whose mind was largely filled with the problem of getting away in time to attend a luncheon, a fashion show, or some other social diversion.

The publications of the Bureau of Mines are evidently of value to the American public because even with our inadequate facilities for bringing them to the notice of the public, and even though they are sold at a nominal price, the Superintendent of Documents sold \$14,000 worth last year of those of our publications of which the free edition had been exhausted. One serious problem with us is the getting out of publications promptly after they are completed. The delay caused by the papers being held in the Government Printing Office is a matter beyond our power to control; however, it ought not to be necessary to hold edited manuscripts six months or more until funds become available so that they can be sent to the Printing Office. The only way to remedy this situation is for the interested public to exhibit its interest, and statements such as the sentence quoted above, which present to the public the wrong view of a situation, are correspondingly to be deprecated.

T. T. READ.

Washington, D. C., March 30.

Russian Placer Mining

The Editor:

Sir—May I be permitted to criticize Mr. Perret's able and interesting paper in the current issue of your publication?

I am sure that if Mr. Perret had been obliged, as I have been, to contend with the frightful disadvantages of steam-driven dredges he would not have commented so severely on the installation by the Orsk Goldfields, Ltd., of an electric power-plant.

Even a modern battleship or a torpedo-boat, or destroyer does not carry as much machinery in proportion to its displacement as a modern gold-dredge; and on the steam-driven dredges the necessary boilers, fuel-piles, and the condensers for such engines as can be run condensing or compounded reduce the available space for gold-saving devices to a ruinous extent as far as economic operation is concerned. The types of engine used on bucket-chains and mooring-winches are not economical in the use of steam. The escaping vapors from leaky piping, wrenched by the vibrations of the machine, are not only annoying to operatives but are active in the promotion of decay in the timbers and consequent shortening of the life of the dredge. The arduous task of conveying the fuel (wood) on board the dredge, the accompanying dirt and expense as well as discomfort, and the extra labor involved in fuel-handling and firing, together with the necessary hauling of the fuel to the bank of the pond so as to be accessible to the dredge, all go to convince one that the electrically driven dredge is so far the best that there can be no question of the economy of its use even at the Kolehan mines.

With the electric plant placed at some convenient spot where fuel can be procured cheaply and hauled to a permanent steam-plant with proper generators and engines of the Corliss or other economical type, and boilers also designed for economy of fuel consumption, a permanent road over which fuel can be hauled in place of a constantly changing one, as is the case when the fuel is burned on board of the dredge, should be in all ways, except possibly first cost of construction, the most economical proposition.

I venture to state that, given two dredges, side by side at Kolehan, one electrically driven and the other driven by steam generated aboard the dredge, the life of the electric dredge (accidents excepted) will be 50% longer than that of the steam-dredge, that it will handle a minimum of 33½% more material than the steam-dredge, will be 100% more economically efficient, and will always command the best help to be had in the district when the steam-dredge will have to hunt for competent help.

Hennen Jennings could have given you some interesting information on this point, as he was formerly interested in the Conrey Placer Mining Co.'s operations at Ruby, Montana, where the use of steam was discontinued and modern electric dredges were built to finish out what the steam-dredges had started. From memory, the working cost of the steam-dredges had been something over 18 cents per cubic yard, not including any amortizations of land or machinery. The electric dredges cut this to below 7c., including proper amortization for equipment and plant, and converted a losing enterprise into one highly profitable. In later years the tailing of the ground worked by steam was re-worked by electricity and the type of tables that are so easily installed on an electric dredge but impossible on a steam-driven one made the re-working of this tailing profitable.

G. L. HOLMES.

San Francisco, March 27.

Amalgamating Practice

The Editor:

Sir—In answer to Mr. Motherwell's enquiry in your issue of March 19 with regard to the results of amalgamation near or at a distance from the battery, the following notes are from actual experience.

The ore was very hard, of low grade, but of good amalgamating character. When amalgamation was practised near the battery a 40-mesh screen was used, the average drop was 7 in., the height of discharge was about 6½ in., and the number of drops was about 100 per minute. The plates were of the usual length and width and the amalgam surface was maintained fairly hard. The tailing passed over Johnson concentrating tables, and the final loss averaged 20 cents per ton. The recovery by amalgamation in the battery averaged 40% of the gold in the ore.

At a later date the concentrating tables were discarded and the plates were removed to the former concentrator floor. The stamps were operated at the same speed and drop as before, but with a 4-in. discharge. The amalgam

surface was maintained in a softer condition; with a 30-mesh screen in the battery the tailing showed a gold content varying from a trace to 20 cents per ton. With a 50-mesh screen the loss amounted to 40 cents per ton.

Results were also obtained by the use of a ball-mill, which delivered direct to amalgamated plates and was fitted with a 30-mesh screen. Although it proved a good crusher it failed to liberate the gold; the tailing never contained less than 50 cents worth of gold per ton, and generally more.

WALLACE J. WILLIAMS

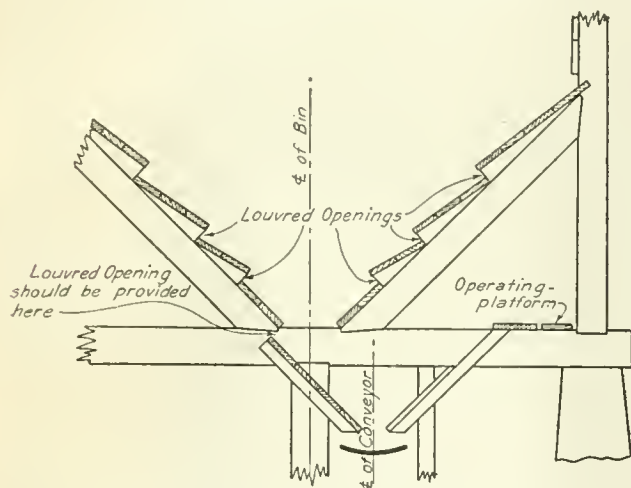
Nevada City, California, March 31.

Louvred Bin

The Editor:

Sir—The suggestion made in your issue of March 5 by W. M. Hutton in regard to the design of a louvred bin, which I described in the issue of January 15, is a good one, but this modification does not take full advantage of the louvre feature; a further improvement is shown in the accompanying sketch.

If it is desired to carry the discharge of the bin to a conveyor-belt situated on one side of the centre line of the



bin, this can be done to better advantage by providing another louvre opening in the bottom, as indicated in the sketch. To continue the bottom of the bin without a break is to disregard the louvre principle at a place where the congestion of the load is greatest and where relief is most required.

An important advantage secured by placing the conveyor belt to one side of the centre line is that a single rather than a double row of columns can be used for supporting the horizontal beams.

NEWTON L. HALL.

Salt Lake City, March 22.

Silver in India

The Editor:

Sir—Having just returned from India I am only now reading the editorial upon silver in your issue of December 25.

You are right in saying that the rupee was quoted at 28 pence but wrong in assuming that this made it worth

56.77c. Indian exchange is given in sterling, not in gold sovereigns. Just at that time a pound sterling was not by any means worth \$4.86. The highest quotation which I remember was eight rupees per pound sterling. It would be enjoyable to send money home at that rate, but just then the postoffice raised its commission on foreign money-orders to twelve annas ($\frac{3}{4}$ rupee or about 30c.) on each pound sterling.

'What goes up must come down.' About February and March 1920 the Madras newspapers quoted 208 bid and 228 asked, in rupees per \$100, so that a rupee was worth about 45c. In December I had to pay 410 rupees per \$100 for my steamer ticket, as a rupee was then worth about 24.5 cents.

Several countries prohibit the export of gold. Is there any except India which prohibits its import? I do not know the wording of the law nor the reason for it but remember that a year, or a year and a half, ago 100 sovereigns were confiscated from a man who tried to smuggle them into the country.

HERVEY GULICK.

Hollywood, California, March 21.

Amalgamation in the Presence of Oil

The Editor:

Sir—Mr. Algernon Del Mar, in your issue of March 19, gives an instance of amalgamating in the presence of flotation oils, to which I would like to add the following observations of my own:

We have been operating a 20-stamp mill on a mixed ore containing heavy iron and copper sulphides and oxidized material. We practised inside amalgamation followed by apron plates and flotation machines, the reagents used being sodium sulphate, P. & E. oil, and pine-oil. Owing to a shortage the water fed to the batteries for a time was clear creek water; at other times it was the tailing-water, containing residual oils and sodium sulphides. A copper plate coated with mercury, over which the pulp was allowed to flow directly after the flotation reagents were added, remained bright and unaffected by the oils, but was quickly fouled by the sodium sulphide; so there was some doubt as to the possibility of re-using the tailing-water. It was found, however, that after the water had been settled in the tailing-pond for even a few hours, and re-pumped to the mill, it would not foul the plates if in cleaning-up a thin coat of amalgam was left. If, however, they were scraped down to the copper, the inside plates would not retain the mercury, which would quickly flake off. There was also a much greater amount of flaking and consequent loss from this cause when using the tailing-water; the amalgam on the inside plates was brittle, and care had to be taken or it would fall off. The outside plates, however, remained as bright and unaffected as when the clean water was being used, and by dispensing with inside amalgamation no bad effects would have resulted from the use of the tailing-water.

The loss of mercury due to the use of the tailing-water was more than compensated by the saving in the amount

of flotation reagents required when re-using the tailing water, the consumption of sodium sulphide being cut down almost two-thirds as compared with the use of the clear water. This did not appear to be due entirely to the proportion of residual sodium sulphide and oils in the returned water, but largely to the longer period of contact when crushing in the presence of the sodium sulphide as compared with the addition of the sodium sulphide at the head of the flotation machine, as was the case when the clear water was used. There was also a corresponding saving in the amount of the oils that had to be added when the tailing-water was used, only about a third as much being necessary as when the clear water was employed.

It would be interesting to know just what proportion of the saving in oils and sodium sulphide was due to the residual reagents in the tailing-water, and what part was due to the longer period of contact with the dilute sodium sulphide. This had gone through a complete aeration, flowing almost a mile to the settling-pond, and the amount of sodium sulphide remaining on its return to the mill was very small, as is evidenced by the fact that the plates were not fouled. The saving made in the reagents appeared to me to be due to the following reasons:

First: The return of some of the reagents added in the first passage of the water through the mill.

Second: The longer period of contact with the sodium sulphide in the tailing-water. The sulphides in the ore were made just as amenable to flotation by the weak solution as they were by the stronger solution and short period of contact when using the clear water and adding the sodium sulphide at the head of the machine. Further, when adding the sodium sulphide to the clear water at the head of the machine, it seemed to be necessary to add a greater amount of oil to give a bubble that would withstand the violent frothing action due to the action of the sodium sulphide on the sulphides in the pulp, whereas when using the tailing-water, though some sodium sulphide had to be added at the head of the flotation machine also, the amount was so much smaller that this violent frothing was absent and less oil would give a froth. The whole pointed toward a possible saving of reagents in many cases by using a very dilute sodium-sulphide solution and providing for a longer period of contact.

LUDWIG C. W. GRAEFE.

Hillsboro, New Mexico, April 7.

The Pittman Act

The Editor:

Sir—It appears that the Pittman Act is to be attacked, evidently with the intent of having the Government repudiate the solemn word upon which many silver miners of the West have been relying in their efforts to replace the silver that was sold during the War. Surely Uncle Sam will look well in the rôle of the broker, buying from his citizens at one price and selling at a nice advance. Perhaps it is the intention of the conspirators in this miserable drama to cast Uncle Sam as the greatest of

profiteers; but, whatever their object, it is safe to say that no law that is framed will produce the effect that is desired.

If the Act is repealed, one of two conditions will occur: either the Government will go into the open market and begin to purchase silver at the prevailing price, or it will cease purchasing altogether. If the latter course be chosen, there will be floating about the markets of the world, as there is today, the greater part of the 207 million ounces that the Government sold as a war measure. This is about four years production for our country, one of the two largest silver-producing nations of the world. This is an enormous amount of the metal, when its effect upon prices is under consideration, and today is by far the most potent factor in forcing the price down to its present figure. Take that 207 million ounces off the market, and guess if silver could be bought for a dollar! If then the Act is repealed, and purchases are not resumed, this 207 million ounces will prove a direct and crushing blow to the silver miner who would produce during the next few years.

If, on the other hand, the Government decides to replace the silver by purchasing in the cheapest market, what will happen? The moment it is known that such a large quantity of silver is to be purchased, the price will begin to advance. The actual removal of the metal from the market in any considerable quantity will cause a rapid rise in price, and it is little, indeed, that the Government will get for some years to come at less than a dollar, and about the chief difference will be that the American producer will have an erratic market instead of a stable one—and the speculators in London, who may not be innocent of fomenting the agitation for repeal—may realize a heavy profit on their holdings, as they will not be ignorant of the effects of the new legislation, although our own Congress may be.

The fact of the matter is that the Government cannot hope to replace the silver much under \$1 per ounce. The only course then, if a profit is to be made, or retained, is to allow the silver reserve to remain depleted. This will overwhelm the silver miner, and may well be said to be what has been stigmatized as the 'tyranny of majorities', for such a condition can only be the result of the failure of the weak piping voice of the silver miner to be heard in the clamor of the thousand opposing interests. Frequently it is said that the silver mines of the Comstock lode financed the Civil War. The silver sold under the Pittman Act certainly was used for the purpose of helping finance the late war. To permit this silver to operate in the markets of the world against the miner of today will not only be a base ingratitude, but will prove fruitless in results, and may find a melancholy echo in a crisis in the near future. It seems then that both policy and conscience demand that the Government stand squarely behind the Pittman Act and refuse to take a temptation to make a profit that, after all, can hardly hope to be materialized.

CHAS. A. PORTER.

Montello, Nevada, April 15.

The New Concrete Shaft of the Chief Consolidated Mining Company

By Arthur B. Parsons

One day last October I went with J. Fred Johnson, general superintendent for the Chief Consolidated Mining Company at Eureka, Utah, from the mine-office to the new three-compartment concrete-lined working shaft situated half a mile north of the present operating plant. There I was lowered 1550 ft. through the middle compartment of the finished shaft and below that through 50 ft. that had been timbered but not concreted. The shaft-crew was preparing to concrete this section by starting

and the timbers themselves were crushed by the pressure of swelling ground although the oldest of them had been in place but 10 days.

The shaft for the first 1600 ft. passes through a soft rhyolite-porphyry which overlies large areas of the limestone in the Tintie district. This porphyry when exposed to air and water slakes and swells; as a result continual repair work is required to keep a shaft in operating condition. Guides must be re-aligned, lagging replaced,



THE PRESENT SURFACE-PLANT OF THE CHIEF CON. MINE. THE NEW SHAFT IS HALF A MILE TO THE NORTH

from the pumping-chamber at the bottom and working upward. The ride through the shaft was in itself an object-lesson; the contrast between the concreted and unconcreted sections suggested the advantages that made it good business to line it with concrete, even during a period when an unprecedented cost for labor and supplies made the work extraordinarily expensive. Although the company does not care to make public the figures on cost, I am informed that for parts of the shaft the expenditure amounted to more than \$75 per vertical foot. The concreted portion was dry, perfectly aligned, and so far as could be seen there were no cracks of any description, although the first concrete had been placed two years before, since which time the work had continued without serious interruption. The lower 50 ft. on the other hand was wet and sloppy; the lagging was bulged and broken,

and timbers eased-off, all of which is exceedingly expensive, not alone because of the material and labor required but because of consequent interference with hoisting.

The Chief Consolidated officials were convinced that an air-tight concrete wall with suitably arranged drain-pipes would effectually decrease this slacking and that if properly reinforced the concrete would withstand whatever pressure might develop. Apparently the soundness of their theory has been demonstrated. Among the other considerations that influenced the decision to concrete the shaft were safety and smoothness of hoisting, the impossibility of a serious fire, and permanence. Realizing that specialized knowledge of reinforced-concrete construction would be indispensable, the mine management called into consultation the firm of Villadsen Brothers.

contractors of Salt Lake City, whose experience in the use of concrete was wide. Engineers for Villadsen Brothers, after a study of the methods used elsewhere in concreting shafts, as well as of the conditions that were to be expected at Eureka, designed the lining, and undertook to supervise all the work except the actual sinking, which was to be done by the Walter Fitch Jr. Co., shaft and tunnel contractors.

In order to economize on concrete it was decided to build a seven-inch reinforced-concrete wall, using the lagging of the temporary timbering for the exterior forms, instead of filling the entire space back to the solid rock. While the Chief Consolidated was by no means the first to undertake the construction of a concrete shaft lining of this character, the problem presented some new features on account of the nature of the ground and accordingly the company was obliged to do considerable pioneering in determining the best methods of accomplishing the work. No standard or generally approved type or method of construction existed.

At the outset plans were adopted for constructing massive supporting collars, or bearers, of reinforced concrete at vertical intervals of 100 ft. extending into special hitches cut into the solid rock. At frequent intervals forms were built and concrete poured to form 'butt-blocks' 12 in. square between the concrete walls and the unbroken porphyry. In each 10-ft. vertical section there were 10 or 15 of these blocks at various points about the periphery. As work progressed experience suggested many improvements so that the original construction, as well as the system of doing the work, has been changed in many particulars. For instance, only three of the large supporting collars were built. Some of these obsolete methods will be alluded to as the subsequent scheme of procedure is being described. It may be mentioned here that after sinking through 1587 ft. of porphyry, the point attained at the time of my visit, the contact with the underlying limestone was reached. For about 50 ft. the ground passed through was badly shattered, but below the 1638-ft. point, in the solid limestone, a form of construction lighter than that used in the porphyry was substituted. The differences will be pointed out later.

The shaft is divided into three compartments, two of which, 4 ft. 4 in. by 4 ft. 6 in. inside dimensions, are to be used as main hoisting-ways, the third, 6 ft. 1 in. by 4 ft. 6 in., provides for a 'chippy' cage together with ladders, water- and air-pipes, and electric cables. In the porphyry the work was done in 2½-ft. vertical sections, the temporary timber-sets, the pre-cast dividers, the concrete forms, and the reinforcing units all being standard at 2½ feet.

Briefly outlined, the procedure was this: The shaft was sunk and timbered for a distance of from 35 to 75 ft. depending upon the amount of movement in the particular section being mined, and the strain thereby put upon the timbers. Concreting was then started from a bulkhead 12 ft. above the actual bottom of the shaft, most of the original timbers remaining in place. Connection was made with the bottom of the previously completed concrete lining, the reinforcement interlocking to form a virtual

monolith. The forms were stripped, and sinking of the next lift commenced at once.

At the start, two separate crews of workmen were engaged alternately; the miners employed by Walter Fitch Jr., working for 10 or 15 days, were followed by the concrete-crew, who spent from 7 to 10 days placing forms and pouring concrete in the section mined. However, the alternation disorganized both groups of workmen to some extent; and, moreover, it was found that the carpenters employed by Villadsen Brothers to place the forms required constant assistance from the miners in easing timbers and doing similar work with which they were unfamiliar. Accordingly after the 450-ft. point was reached Walter Fitch Jr. undertook all of the underground work, the same crew of miners and timbermen doing the form-work and pouring during intervals between sinkings. The designing, the mixing of the concrete, and the making of the pre-cast dividers, the forms, and the 'mats' for reinforcement were still done by the Villadsen firm. The surface plant included a sawmill for framing timbers and sawing plank for forms; a large building where the pre-cast dividers, beams, and platforms were made; a boiler-house for heating the water and aggregates to be used in the concrete; the concrete-mixing plant; a hoisting-house; and sundry offices.

It was originally planned to pre-cast the end-pieces as well as the dividers, so that forms for the sides only would be required. However, the solid ends, being much heavier and larger, were difficult to handle, progress was slow, and this scheme was abandoned after a short trial. The advantage, if any, was more than outweighed by the excessive cost. The pre-casting of the dividers, however, afforded definite advantages. They were made either with an open panel, as shown in the accompanying illustration, or solid, depending upon the nature of the ground in which they were to be used. The reinforcement was also varied to meet the requirements of the ground. The reinforcing steel was in the form of plain medium open-hearth bars, round and square.

Reinforcement for the sides and ends was 'fabricated' into 'mats', by means of wire, ready to be lowered down the shaft as required. These mats were carefully designed to assume the tensional strains and to bind together the successive vertical sections by means of interlocking half-inch round bars. The standard concrete mixture for all purposes was 1:2:4, although a richer mixture was sometimes made for special work.

In order to get the best grade, sand was shipped 95 miles from Salt Lake City. Quartzite tailing from the old May Day mill at Eureka was used as the coarse aggregate; the cement was supplied by the Ogden Portland Cement Co. from its plant at Bingham City, Utah. Extreme care was exercised in sizing and proportioning the materials to get a strong dense concrete; hot water and heated aggregates were used in order to shorten the time required for setting. This was done in summer as well as in winter. The aggregates were elevated to separate storage-bins in the mixing-plant by means of a 10-in. bucket-elevator; they were drawn off into measuring-hoppers, and thence gravitated to a ½-cu. yd. chain-



A ROW OF 'PRE-CAST' DIVIDERS, AND A FRAME OF REINFORCING-STEEL

driven Boss concrete-mixer that discharged into a mine-bucket with a capacity of 10 cu. ft., which was trucked to the collar of the shaft, or into carts in which the concrete was taken to the pre-casting building.

The shaft was served by two single-drum hoists of Denver Engineering Works manufacture, geared to 75-hp. General Electric motors, the buckets being provided with cross-heads of ordinary design. Three shifts were employed on the work, the underground crew on each shift being composed of five miners at \$6.50 per day, one timberman at the same rate, and a boss-timberman at \$8 per day. The miners either drilled or shoveled interchangeably; and when the concreting was being done they divided the task of placing forms and pouring the concrete so as to advance the work to the best advantage.

There was nothing unusual in the method of sinking. The ends of the shaft were drilled and blasted alternately,

16 holes being required to break a five-foot round in one end. About 40 minutes was allowed for the smoke to clear before the men returned after the holes had been fired. The time required for drilling a round was approximately equal to that consumed in loading the broken rock, an average of two rounds per 24 hours having been maintained much of the time. During September 1920, 100 ft. of sinking was recorded in 20 days, and 80 ft. of concreting in 10 days, all through porphyry.

Three Waugh D.D.R. 52 Clipper drills were used at one time, with enough extra machines available to have three in first-class condition. The $\frac{3}{8}$ -in. hollow hexagonal steel was plugged at the side rather than at the end because the soft porphyry made it difficult to keep the hole from filling with clay. A blunt ear-bit was used. Du Pont 40% powder, detonated by an electric-blasting machine, and delay exploders furnished by the New York Blasting & Supply Co. were used for most of the sinking, although

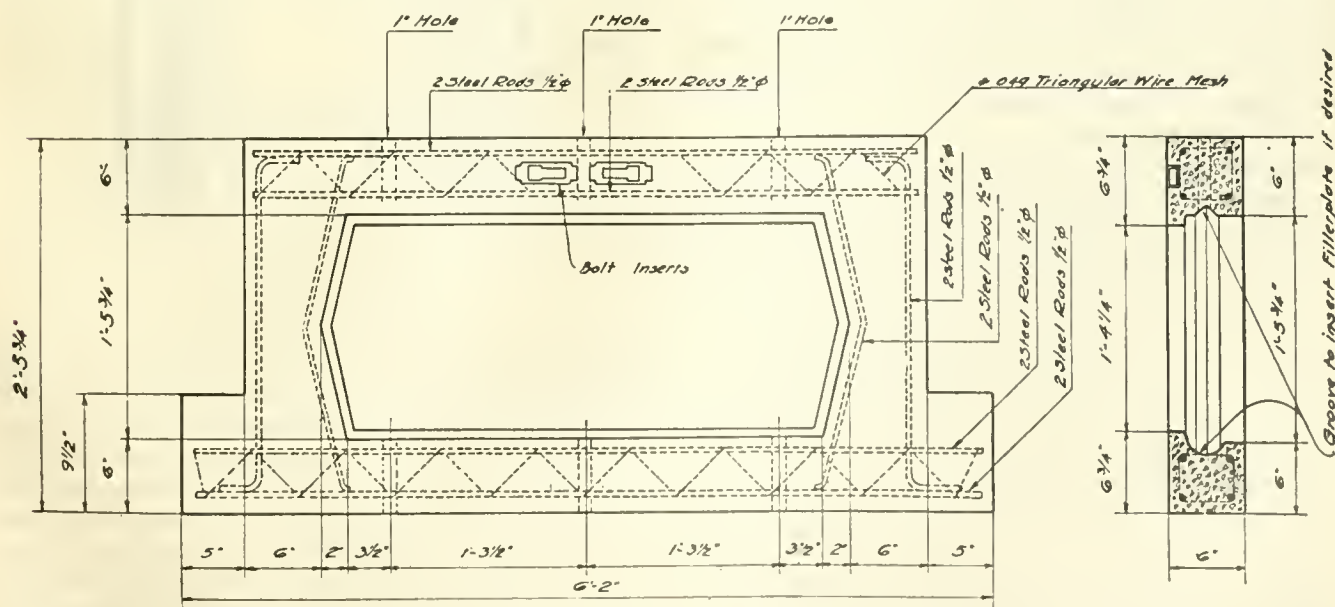


FIG. 1. DETAILS OF REINFORCEMENT FOR A DIVIDER

ordinary water-proof fuse was used at the start, and did not give any trouble. When the shaft became deeper electric firing was introduced largely as a measure of safety.

Timber sets were placed at 2½-ft. centres as sinking progressed. These sets were lighter than those ordinarily used, being framed of 6 by 6-in. material. Along the top and bottom of both end-plates and side-plates was a channel formed between two strips of square material spiked to the large timbers. This channel was 2 in. wide and was used for the two-inch lagging, set vertically, which became the outside concrete form, and took the place of posts. This timbering was done concurrently with the mining by the timbermen working on a suspended structural-steel bulkhead. The bulkhead was approximately the same size as the excavation with only sufficient clearance to permit it to be lowered readily by means of two one-ton chain-blocks rigged from temporary timbers spanning the wall-plates two or three sets above. The bottom of the bulkhead was shielded from the blasting by ½-in. steel sheets bolted to the under side, and it in turn protected the temporary timbering and the finished concrete from the effects of the blasting when sinking was resumed after the completion of a section of concrete. A plan devised for handling ground that swelled rapidly was to replace the lagging with concrete. If a row of lagging began to bulge badly it was removed and the ground behind it dug away for six or eight inches. New lagging was put in, steel reinforcement was placed, and concrete was poured from above. When this had set, the lagging was stripped. The effect was to check the swelling to some extent and to leave the block of concrete where it became part of the completed wall when the regular pouring was done. A necessary precaution was to confine this concrete to the space behind the lagging and to avoid getting it behind the 6 by 6-in. plates. There was then room for some inward movement of the concrete without necessarily disturbing the timbers. This procedure was resorted to frequently; it was effective, it did not interfere with operations in the bottom of the shaft, it left the walls in such shape that rapid progress could be made with the work of pouring the concrete, and it permitted the sinking of a longer section of the shaft before concreting became necessary.

When it appeared to be advisable to discontinue sinking and resume concreting, the first step was to construct a substantial temporary bulkhead, two sets above the steel working bulkhead, as a foundation for the concrete. This was underpinned by several posts footing on the rock bottom. The exact position of the inside corners of the lining was then determined by plumbing from the concrete above. The pre-cast dividers for the bottom section were put in position with the heavy lugs on the lower side wedged against the wall-plates. The timber dividers were purposely spaced so that they could remain in place until concrete dividers were in position; then they were removed. The accompanying photograph shows a row of twenty pre-cast dividers, together with a mat of reinforcing steel which was to be used in pre-casting. The principal advantage of casting these di-

viders on the surface instead of underground was to simplify the construction of the forms in the shaft, thereby saving time. The large lugs extended into and became part of the wall. The sketch, Fig. 1, shows the arrangement of the reinforcing steel, and likewise the steel bolt-insert in which the heads of the guide-bolts were placed. The guides were set about half an inch from the concrete, thin wooden shims being used to off-

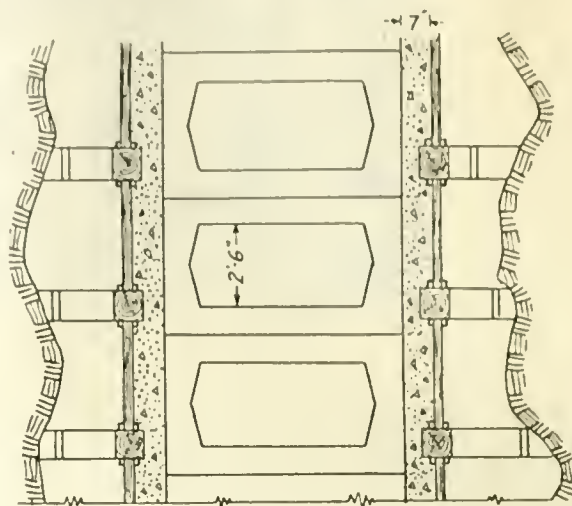


FIG. 2. SKETCH SHOWING TYPE OF CONSTRUCTION USED IN THE RHIVOLITE

set any slight irregularities in the wall. The purpose of tapering the ends of the open panel was simply to facilitate stripping the form. When unusual strength was re-

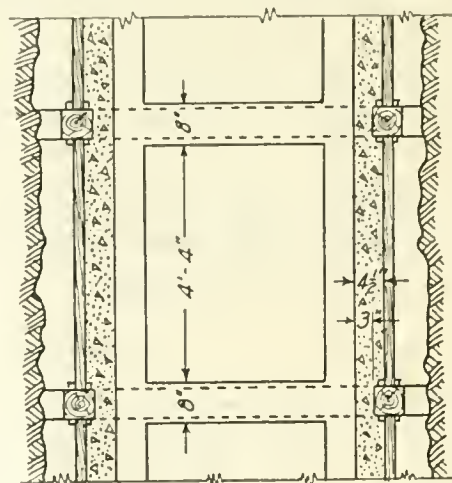


FIG. 3. SKETCH SHOWING TYPE OF CONSTRUCTION USED IN THE SOLID LIMESTONE

quired no open panel was left in the dividers. The eight reinforcing mats for the sides and walls were next hung in position and the eight corresponding sectional forms for the inside of the wall were placed. The forms were made of two-inch plank and were oiled on the face side. The interior corners were occupied by triangular strips; they were made independent of the forms in order to facilitate stripping. The forms were held by means of 4 by 4-in. wooden braces while concrete spacer-blocks assured the proper spread between the forms and the wall-

plates. Ordinarily the lagging was removed from the first two or more courses, so that the concrete might extend to the porphyry wall and give solidity to the bottom of the new section. Thereafter the local character of the ground determined how frequently the wall should be run to solid rock.

The original plan provided for a large number of small 12 by 12-in. concrete butt-blocks between the shaft-lining and the solid rock. There were to be two or more of these for every 2½-ft. section of shaft, each requiring a separate box-form and special reinforcement. However, the construction and filling of the forms was tedious and expensive and the method was discarded early in the work. Another scheme was to pour 5-ft. vertical sections 'solid' that is, fill the entire space to the porphyry with concrete, leaving intervals of 10 ft. between each pair of filled sections. However, this required more concrete than was really necessary in portions of the shaft where the ground was not particularly heavy. The procedure subsequently evolved took into consideration the particular requirements of the ground being passed through; there were frequently vertical sections as long as 20 ft. where no projections whatever were required from the 7-in. concrete wall to the solid rock.

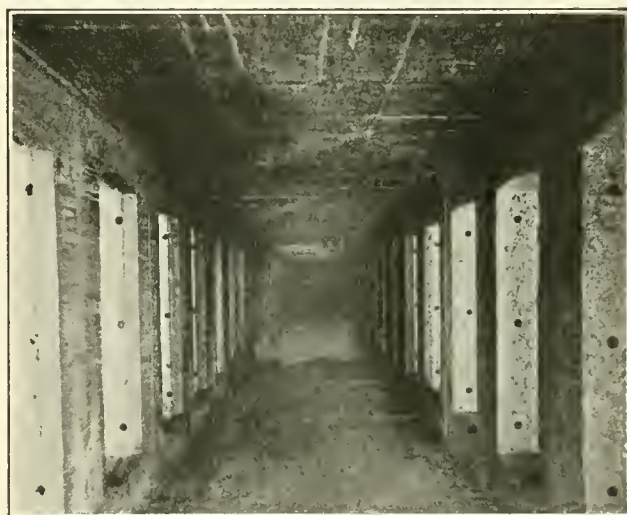
Mention has been made of solid concrete 'bearers' that were to be placed at intervals of 100 ft. A special hitch entirely surrounding the shaft was cut into the porphyry. This hitch extended three feet into the rock and was about 30 inches high with a square shoulder below a 45° taper back to the regular excavation at the top. Reinforcing steel and pre-cast concrete beams were placed and concrete poured to fill the hitch, thus making a heavy concrete collar designed to be strong enough to support three times the weight of the concrete in a 100-ft. section. Only three of these bearers were put in, however, as it became apparent that they were unnecessary. The first 50 ft. of the shaft was concreted 'solid' with the idea of getting a good start in the looser porphyry. This was, of course, expensive but the policy at the start was to have a large, even an excessive, factor of safety and to make the changes that became advisable as the work progressed.

Reverting to the method of pouring the concrete: it was lowered in a regular 10-cu. ft. mine-bucket, from which it was dumped onto a shoveling-platform supported on the concrete forms. Various schemes for dumping the bucket into chutes leading to the form were tried, but on account of the thinness of the walls it was found necessary, in order to make a denser concrete, to shovel the mixture by hand from a platform. The foreman attended to the plumbing of the shaft and the results speak well for his care and accuracy. The last monthly report of the engineers at the time of my visit had recorded an error of $\frac{3}{16}$ inch in one direction, and in the other the result was an actual check. I was told, however, that there was at one place a slight bow in the shaft, the alignment varying some three-eighths of an inch, the result of getting off and then coming back to plumb. The foreman spoke apologetically of this, rather unnecessarily, it would seem.

Pump-stations have been cut at intervals of 300 ft.,

this being the maximum efficient lift of the air-driven sinking-pump that operated beneath the structural-steel bulkhead. Electrically-driven plunger-pumps lift the water from the stations to the 1000-ft. level, where it flows through a drift to No. 1 shaft. Drainage from behind the shaft-lining is effected by means of numerous perforated pipes that are set solidly in the concrete and connect with vertical pipes leading to the station-sumps. It is important that there be no free circulation of air through or around the drain-pipes, because this is one of the factors that affect the slaking and swelling of the porphyry.

Immediately below the weak point at the porphyry-limestone contact a section of 40 ft. was concreted solidly to the limestone. From that point to the bottom of the shaft, at 1910 ft., the concrete lining is 4½ in. thick instead of 7, and instead of the heavy divider-frames used



LOOKING DOWN THE CENTRAL COMPARTMENT OF THE SHAFT

above, lighter pre-cast horizontal strut-beams, 6 by 8 inches in cross-section, have been used. These are spaced 5 ft., centre to centre, and are connected by pilasters, the concrete for which was poured at the same time as that for the walls. False timber dividers were not used; the pre-cast concrete beams were placed in position, being held there temporarily by means of two dowel-pins, one east in each end and extending into a hole drilled in the adjacent wall-plate. At intervals of 30 ft., sections five feet high are poured solid to the limestone wall to afford additional strength. See Fig. 3.

The concrete for the entire lining in the limestone was poured in only two sections; indeed the whole length, 272 ft., might have been poured at one time except for the fact that additional forms would have had to be constructed. This indicates the marked difference between the character of the porphyry and that of the limestone.

Three stations from which drifts will connect with the workings from No. 1 shaft were constructed in the limestone portion of the shaft. Fig. 4 shows how the openings for these stations were left in the concrete lining. For a distance of 5 ft. above and 8 to 11 ft. below the station the shaft-concrete was made solid, that is, it ex-

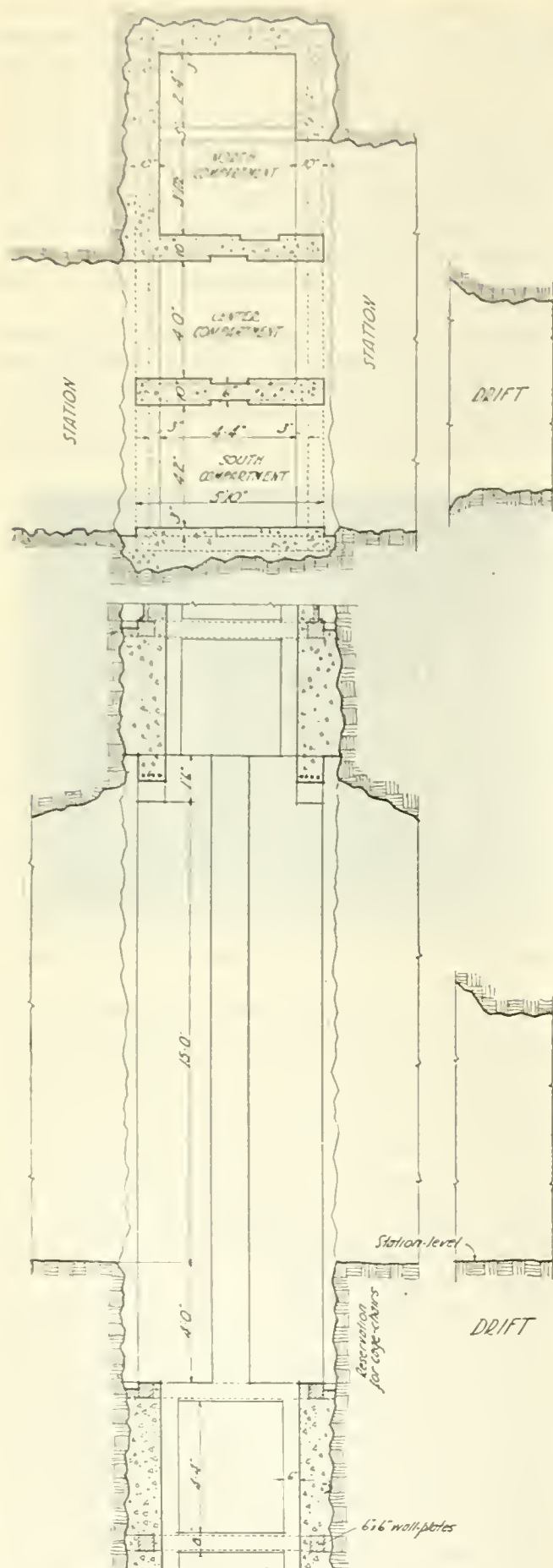


FIG. 4. PLAN AND SECTION AT A STATION

tended to the undisturbed limestone wall. The continuity of the concrete structure was preserved by placing heavy division-walls through the open section, instead of the lighter dividing beams used elsewhere. These solid walls were made 10 in. thick to give adequate compressive strength. To provide for the cage guides this dimension was necessarily reduced to 6 in. at the centre. To provide further rigidity at the station opening heavy struts connected the division-wall at the brow of the station. All of this was, of course, specially constructed concrete work, designed by Villadsen Brothers.

On December 31, 1920, concreting had been completed, the forms were all removed, the shaft was cleared and drifting was commenced from the station at the 1880-ft. level, the lowest in the shaft at the present time. The following resumé of the complete undertaking would be more illuminating if it included the cost. It is, however, interesting.

Porphyry passed through	1587 ft.
Limestone passed through.....	323 ft.
Time sinking in porphyry.....	484½ days
Time sinking in lime.....	44 days
Time concreting	295½ days
Average progress sinking in porphyry....	3.2 ft. per day
Average progress sinking in lime.....	7.32 ft. per day
Average progress in concreting.....	6.46 ft. per day
Average progress entire operation.....	2.31 ft. per day

The Chief Consolidated is one of the most progressive companies in the West and for the last few years has been by far the most important producing mine in the Tintie district. Cecil Fitch is manager for the company at Eureka and J. Fred Johnson is superintendent. I am indebted to them for courteous treatment while at the mine.

SOUTH-WEST AFRICA's mineral output has, hitherto, been almost wholly confined to diamonds from the Luderitzbucht-Kolmanskop-Pomona coastal region and to copper from the Tsumeb-Otavi mines toward the north-eastern corner of the territory, states a consular report. The presence of other minerals has, however, been known, and in the past few years there has been a considerable exploitation of cassiterite in the Karibib and Omaruru districts. A British syndicate controlling a number of gold and coal mining properties in the Transvaal has recently purchased, in the Omaruru district, a tin property that has been operated on a small scale. Another important tin flotation is that of a company registered in the province of the Cape of Good Hope. This company has an authorized capital of £100,000, and was formed for the purpose of acquiring from a syndicate, known as the Asbestos and South West Protectorate Venture, 16 base-metal claims and 17 prospecting claims situated in the Omaruru district, South-West Africa, having an area of approximately 8 square miles. The report of a mining engineer shows that the property consists mainly of a ridge made up of approximately 450 tinbearing reefs, the lengths and widths of which vary from 300 metres (over 300 yards) to 3.5 kilometres (2 miles) and 15 centimetres to 3 metres, respectively.

The Need of Quantitative Methods in Applied Geology

By Charles H. White

Geology, like the other sciences, can be of service only to the degree that its methods are exact. In other words, the usefulness of the science is measured by the precision of its technique.

The science of geology had its origin in the union of the speculations of philosophy with the small body of facts regarding rocks, ores, and other minerals accumulated in the course of the winning of the metals and the useful minerals; a union of the *a priori* with the empirical. These two methods of attack have come down to us from the time that man began to make history, and, indeed, both are still extant, although happily no longer of equal authority. According to the Scriptures, while Tubal Cain was beating out useful implements of brass, cosmic philosophers were expounding how "the land was separated from the great deep" and how "the mountains were brought forth".

In consequence of the production of silver from the mines at Laurium, which have been worked from prehistoric time, Attic philosophers were able to sit in their academic shades and discourse on the origin of fossils, volcanoes, and earthquakes.¹

Throughout the ages there have been the two classes of contributors to the stream of human knowledge. The one, out of the operations of the brain alone, by sheer power of thought, elucidates all manner of phenomena, whether terrestrial or celestial, and all of man's relations to his environment, whether temporal or eternal; the other, working not only with the brain but with the hands as well, carefully measures and tests and proves by experiment—as far as it is possible to do so—the truth or falsity of the hypothetical creations of the imagination.

The two methods of approach are well illustrated by a controversy related by President Goodnow of Johns Hopkins University, which took place between two men, on the deck of a steamer ploughing through the Gulf Stream at night, regarding the origin of the phosphorescent glow following the trail of the propeller. One of them was a dignified devotee of pure thought, and the other a grubbing student of zoology. When the zoologist maintained that this fascinating trail of light was due to myriads of a minute form of animal life, the reverend gentleman replied in great astonishment that such a cause had never occurred to him although he had given the subject a great deal of thought.

All the physical sciences have come through the same struggle. After centuries of the gropings of alchemy, chemistry had its birth with the discovery of oxygen and the laws of constant and multiple proportions, less than

a hundred and fifty years ago. A little more than a decade later James Hutton, a Scot, published the first book on geology that had any semblance of "organized common sense", to use Huxley's definition of science.

Geology, then, as a science, can be said to be only about a hundred years old. Since the days of Hutton there has been a gradual emergence from the chaos of hypothetical dreams, although in comparison with other sciences the rise seems extraordinarily slow. Perhaps the reason for this lag behind the other applied sciences is justifiable. Its problems, to us, seem more profound. Data are sometimes difficult and expensive to obtain. The physician can easily test his theory, for he can lay open his subject and view the results of his experiment; but erosion and the miner combined have only scratched the epidermis of the earth. The constitution of the sun is probably better known than that of the interior of the earth. Even the topography of the earth is not so well known as that of the side of the moon which is turned toward us. Geology is not slow in propounding problems, but she waits for chemistry, physics, mineralogy, and paleontology to supply the tools with which to solve them.

In the last twenty years geology has been far outdistanced by the other applied sciences. Compare, for example, the brilliant step in surgery and medicine from Spanish War methods to World War methods, or the rejuvenation of chemistry through the discovery of radium and all its hopeful progeny. Other examples of progress, while geology in comparison has slept, are in locomotion and in the transmission of thought. In locomotion the methods of the early Egyptians have survived so long that it is only in our day that they have given way to the electric car, the automobile, and the aeroplane; and in the transmission of thought—I do not refer to the methods of Sir Oliver Lodge—we have communication by wire and by wireless.

To illustrate the slow development of the scientific method in geology, let us take, for example, the subject of vulcanism, the phenomena of which perhaps are the most striking of a geological nature that interested early man and that were undoubtedly the most important to those who lived within the danger-zone of volcanoes. In spite of the general interest in volcanoes and their very special importance to large groups of people, surprisingly little is known of their origin or their habits, and almost no progress has been made in foretelling their behavior.

My first experience with volcanoes was at Vesuvius shortly after the great eruption of April 1906. The lava had pushed its way down through the village of Boseo Trecese, tearing asunder small residences, surrounding the larger buildings, and covering the railroad to a depth

¹While the mines at Laurium were the property of the State, their proceeds were distributed among the citizens after the ordinary expenses of government were paid.

of ten to fifteen feet. It had only just solidified and was still too hot to walk upon. The mountain could not be approached from that side, being well guarded by both hot lava and a detachment of soldiers. I drove around to the east side, to the town of Ottajano, where guards were not so much in evidence. Here the volcanic ash and lapilli had fallen to a depth of several feet. The great weight of it on the roofs had carried many of them with all that was in the house, including the dwellers, into the cellar. The entire population, except a few guides and guards, was wholly occupied in clearing the ash away from the vines and fruit-trees, from the streets, and from the ruined houses in the effort to recover their dead, so that I was able to slip out of the town unobserved and to climb unmolested and alone to the top of Monte Somma.

From Monte Somma, which is the remnant of a greater prehistoric Vesuvius, I could look across the Atrio del Cavallo, a distance of about half a mile on a level line, to the active crater of Vesuvius. Smoke and ashes were rising, now calmly and majestically, and again violently and in greater volume. The immense black cloud spreading over the surrounding country, and condensing, splashed the landscape with great drops of mud. Such a sight for the first time is a remarkable stimulus to the imagination.

The material ejected from the crater came down only in splashes; the unanswerable questions provoked by this awe-inspiring spectacle came as a deluge. I was oppressed not only by my own ignorance but by that of all mankind. Vesuvius had received the attention of writers long before the Christian era. Strabo had pronounced it a volcano before the time of any known eruption and while it was still apparently extinct. The first recorded eruption was that which destroyed Pompeii in August 79 A.D. This was observed by Pliny the younger, who, in letters to Tacitus, described certain of the events in considerable detail, and in spite of the 1827 years of intervening study of volcanoes between his visit and mine, he was apparently about as competent to understand the phenomena as I was. He, his mother, and his uncle, the elder Pliny, were living at Misenum, where his uncle was in command of the fleet. Misenum is on a point on the west side of the Bay of Naples, 17 miles west of Vesuvius. In his letter Pliny writes:² "On the 24th of August, about one in the afternoon, my mother desired my uncle to observe a cloud which appeared of a very unusual size and shape. . . . He immediately arose and went out upon a rising ground from whence he might get a better sight of this very uncommon appearance. A cloud . . . was ascending, the appearance of which I cannot give you a more exact description of than by likening it to that of a pine-tree, for it shot up to a great height in the form of a very tall trunk, which spread itself out at the top into a sort of branches; occasioned. I imagine, either by a sudden gust of air that impelled it, the force of which decreased as it advanced upwards, or the cloud itself being pressed back by its own weight, expanded in

the manner I have mentioned; it appeared sometimes bright and sometimes dark and spotted, according as it was either more or less impregnated with earth and cinders. This phenomenon seemed to a man of such learning and research as my uncle extraordinary and worth further looking into."

He then described how his uncle, when about to set out in a light vessel to cross over to observe the eruption, gets a message from a friend that the towns on the shore at the foot of Vesuvius are in great danger, changes his mind, orders the galleys to put to sea, and "what he had begun from a philosophical, he now carries out in a noble and generous spirit". The writer then depicts how as the ships approach the mountain "the cinders, which grew thicker and hotter, fell into the ships together with pumice-stones and black pieces of burning rock; they were in danger too of not only being aground by the sudden retreat of the sea but also from the vast fragments which rolled down from the mountain and obstructed all the shore."

He follows with an account of his uncle's landing at Stabiae, going for the night to the house of a friend, how stones and ashes fell on the houses at such a rate that fearing they would be trapped, they held a consultation as to "whether it would be most prudent to trust to the houses which now rocked from side to side with frequent and violent concussion as though shaken from their very foundations, or fly to the open fields where the calcined stones and cinders, though light indeed, yet fell in large showers, and threatened destruction. In the choice of dangers they resolved for the fields. . . . They went out then having pillows tied upon their heads with napkins; and this was their whole defense against the storm of stones that fell around them. . . . They thought proper to go farther down upon the shore to see if they might safely put out to sea, but found the waves still running extremely high and boisterous. Then my uncle laying himself down upon a sail-cloth, which was spread for him, called twice for some cold water, which he drank, when immediately the flames, preceded by a strong whiff of sulphur, dispersed the rest of the party, and obliged him to rise. He raised himself up with the assistance of two of his servants and instantly fell down dead, suffocated, as I conjecture, by some gross and noxious vapor".

At the time of my visit in 1906, while standing on Monte Somma, I also got a strong whiff of sulphur and found myself conjecturing about the "gross and noxious vapor".

Up to that time gases from fumeroles and earth-cracks near craters had been analyzed; that is, we knew qualitatively in a general way what gases sometimes escape in volcanic districts; but we did not know, and do not know yet, anything of the quantity of the various gases, including water-vapor, that is discharged through any continuous period at the time of an eruption.

In 1858 Deville and Le Blanc published results of analyses of gases, which indicated that the nature of the emanations from a volcanic district varies with the time

²Translation by William Melmoth.

that elapses after the beginning of an eruption; that is, there is a relative decrease of chlorine and sulphur gases and an increase of carbon di-oxide; but apparently no one has tried to learn if eruptions can be predicted by observing if the reverse variations take place as an eruption approaches.

Upon my return home I inquired of certain institutions organized for research if they would be interested in the study of gases from craters, in taking lava temperatures, etc. The Carnegie Institution of Washington was very much interested, and since that time it has made some important studies on volcanoes. In 1909, for the first time, the temperature of lava in a crater was taken at Kilauea. Three years later, at the same place, also for the first time, gas was withdrawn from a crater for analysis. Since that time other volcanic districts have been visited by members of the staff of the Geophysical Laboratory and numerous samples of gases collected for analysis from fumeroles and quiescent craters; but I would not regard the study of a volcano to have been seriously undertaken until its gases are sampled and analyzed automatically and continuously and the results recorded on a dial, along with the temperature, in the same way that these operations are carried out at chemical and metallurgical works and at power plants. If we had the continuous record of the carbon di-oxide, sulphur di-oxide, hydrochloric acid, and water from a few craters from one eruption to the next, as well as the continuous record of temperature, no one can predict what benefits might ensue.

Naturally enough the expense of installing the necessary equipment for such work discourages the undertaking. Automatic, or mechanical, gas-analyzers would be required and also the necessary pipe to connect the apparatus with the volcanic vent through which the gases could be drawn continuously, and the pipe would have to be made of fused silica or other refractory material.

After centuries of apparently no progress, a beginning has been made at last. It was about 1912 that Perret, by the use of the microphone, in an Italian volcanic district was able to predict an eruption and give timely warning of its approach. In 1914 I found that a concrete base was being placed in the Vesuvius observatory for the installation of the first seismograph at that station, and Professor Malladra, the director, showed me a temperature curve of the fumerole in the crater of Vesuvius that he had made through a period of several years, proving that the temperature was uniformly higher in winter than in summer; the higher temperature in winter being due, as he said, to the water added by the increased rainfall of winter.

Philosophical speculation long dominated in the field of geology. Aristotle taught that earthquakes were caused by the generation of wind within the earth under the influence of the warmth of the sun and the internal heat. From Aristotle to Agricola is a leap of nearly nineteen centuries; but we find Agricola, who was the author of the first serious work on mineralogy, as late as

1546 urging his mining students to study philosophy so that they might "discern the origin, cause, and nature of subterranean things; for they will be able to dig out the veins easily and advantageously and obtain more abundant results from their mining".³ Even Gottlob Werner, who followed soon after Agricola, and for about forty years was the great geological enthusiast at the Freiberg Mining Academy, and died only about a hundred years ago, taught that all rocks, crystalline as well as non-crystalline, were precipitated from the primeval ocean and followed in the same succession the world over. He also believed that volcanoes resulted from the burning of subterranean beds of coal.

In the field of economic geology, as well as in other branches of the subject, the development of the quantitative method has been slow, but even with his limited technique the economic geologist has been able to assist the miner in following his ore through the vicissitudes of folding and faulting where the deposit was bedded or in sheet-like form. He has also been able to locate artesian water and to pick out favorable spots for pools of petroleum. With the aid of the magnetometer, he has been able to find and map concealed bodies of magnetite and also to locate non-magnetic bodies of iron ore where these bodies occupied a certain definite relation to magnetic beds that were themselves too lean in magnetite to constitute ore—a method very successfully applied in Michigan and elsewhere. He has been able to predict with tolerable accuracy extensions of orebodies where mineralization favors certain rocks in preference to others, through his ability to identify the rocks and to determine the structure. His services have been in demand in war as well as in peace. General Pershing had a geologist on his staff in France, and through this branch of the service trenches, dugouts, and other earthworks were placed favorably to avoid troublesome rock-structures, especially water-bearing beds. The geologist, indeed, is able to assist in practically all large undertakings that involve operations in or on the materials of the earth's crust. In agriculture, war, water-supply, fuel-supply, road construction, and many other branches of engineering; in mineral production of all kinds, and especially ore production; and in his every sphere of activity, the value of his service increases as his methods approach quantitative accuracy.

As an illustration of the advantage of the quantitative method as applied to ore-finding geology, let us consider briefly some of the criteria for judging croppings of disseminated sulphide deposits. If erosion has brought the surface down to or within a few feet of the primary ore, the two important considerations—the grade of the ore and the size of the deposit—become comparatively simple. By a surficial examination, possibly with some trenching, the grade of the ore and its areal extension are determined; the depth only remains to be ascertained. This resolves itself, so far as the geologist is able to assist, into a problem of structural geology.

But let us suppose that oxidized croppings of unknown

³'De Re Metallica', Hoover's translation.

depth over a large area are colored with limonite and show a marked amount of sericitization, kaolinization, or silicification, or all three combined, what can the geologist tell of the probabilities of ore below? Let us see what is the status of our knowledge on the subject.

The literature on croppings is not extensive nor is it always strictly scientific. Two characteristics are usually dwelt upon as being of greatest importance: the color of the croppings and the degree of silicification. We will consider for a moment the first of these characteristics, the color of the limonite, and take up for comparison what current technical literature has to offer about Miami in this regard.

J. Parke Channing states that the cropping is stained red in patches by iron oxide and only occasionally by small green copper stains.

Ransome says that the largest orebodies at Miami "are not often found under those surface rocks that are most vividly colored by copper compounds or iron oxides".⁴

F. H. Probert states that "at Ray and Miami the color over schist ore is pale chocolate-brown and copper silicate at the surface".⁵

Channing says the cropping is red in patches; Ransome that the reddest ground is not over the best ore; and Probert that it is a pale chocolate-brown. While these statements perhaps cannot be strictly construed as conflicting, yet they do not lead unerringly to a conclusion. It is a very simple matter by means of the Maxwell color-wheel to resolve a color into its elements and to determine precisely the percentage of each of its components. Practically all writers on this subject regard the color as very important, yet they have not considered it sufficiently important to make strictly accurate quantitative statements regarding it.

By a careful study of the surface at Miami it has been found that the croppings of the disseminated sulphides may be divided into three areas, each having its own peculiar color. On the south side of the Pinto fault—the up-thrust side of the fault—the color is lighter, almost suggesting pink, with an occasional copper stain. North of the fault, but still over the orebody, the color is more distinctly red. Still farther north, beyond the orebody and over pyritic ground, the red is still deeper in color. In an effort to establish a quantitative basis on which to compare these colors, I analyzed the colors of several specimens from these two areas, respectively over ore and over pyrite. I found that in both areas the color was composed of red, yellow, black, and white; but there was on the average a considerably higher percentage of red, yellow, and white over the orebody than over the poor ground; in fact, there was twice as much white in the color over the orebody as in that over poor ground, and four times as much black in the poor ground as in the good ground. While no definite and important conclusions can be drawn from these few tests, even in one district, yet the trial suggests the possibilities of the method and leads us to wonder what might be the result

if we could have such tests made on large numbers of samples from many disseminated deposits.

As to the second characteristic, opinion seems to be practically unanimous that croppings of disseminated orebodies are more highly siliceous than similar croppings of disseminated sulphides poor in copper; but quantitative statements on the subject, I believe, have never been published. As an effort in this direction, I examined carefully with the hand-glass about 90 samples from Miami, about one-third from over the ore and two-thirds from pyritic non-orebearing ground, and estimated as accurately as I could the content in quartz, having in mind that only the mineralization quartz was important. As a result of this test I found that there was on an average nearly twice as much quartz in samples from the orebearing ground as in those from the non-orebearing ground. A number of determinations on other characteristics of croppings were made, but the examples given are sufficient to indicate that this is a promising field for investigation. The importance of such quantitative studies is apparent when we realize that it was probably the lack of such a technique that resulted in the failure of the Miami company to obtain possession of what is now Inspiration ground.

These examples of the very inadequate study of two characteristics of croppings show how little is really known about croppings, and suggest the importance of applying every possible method of measurement to all the variable characters of croppings to determine if possible the significance of the variations.

As a possible aid to those who may wish to study croppings in a quantitative way there is outlined below a method of mapping and note-taking, which I have used with considerable satisfaction. By this method the degree of development of numerous and oft-repeated characteristics may be recorded rapidly (and in a roughly quantitative way) in a small space. Suppose, for example, it is desired to record at frequent intervals the following characteristics:

1. Texture of the rock, degree to which it is preserved.
2. Fractures, distance apart.
3. Kaolinization, intensity.
4. Silicification, general, intensity.
5. Quartz in veinlets, distance apart.
6. Limonite, soaked into kaolin, paint on joints, pseudomorphous after pyrite.
7. Limonite in veinlets, distance apart.
8. Limonite, disseminated, frequency.
9. Sericitization, intensity.
10. Copper stain in kaolin, intensity.
11. Copper stain in veinlets, distance apart.

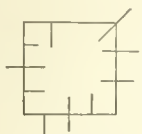
By this method each characteristic is represented by a line which cuts a side of a small square or other polygon, always in the same position with reference to a beginning-corner. The degree to which the characteristic is developed is represented by the depth to which its line penetrates the polygon. If the line is wholly within the polygon, the characteristic represented by it is little developed. If the line cuts the periphery, the character-

⁴U. S. G. S. Bull. 529, page 186.

⁵M. & S. P., June 17, 1916.

istic is moderately developed; and if the line lies outside the polygon, it is highly developed. The first character recorded is represented by a line set diagonally at the beginning corner of the polygon; all other lines are set at right angles to the sides of the figure, and are read clock-wise, each line, by its position, always representing the same characteristic in any one district. The system may be changed from one district to another by using the lines to represent other characteristics which it is desired to record.

For example, this symbol



means, that

1. The texture of the rock is partly gone.
2. The fractures are, say, from $\frac{1}{2}$ to 2 in. apart.
3. It is partly kaolinized.
4. Slight silicification.
5. Quartz veinlets from $\frac{1}{2}$ to 2 in. apart.
6. Limonite soaked into kaolin.
7. Limonite veinlets more than, say, 2 in. apart.
8. Limonite disseminated in specks, say, 25 per square inch.
9. A little sericite.
10. A little copper stain.
11. No veinlets of copper.

By this method notes that would require half a page in the ordinary note-book may be recorded in less than a quarter-inch square. This has been found useful, not only in recording information on surface maps, but also in note-taking underground. From these notes, maps may be made to show areas on which the various characteristics predominate, singly, or in any desired combination.

When we consider how much is still unknown regarding the occurrence of ores it seems truly surprising that the service of the geologist is so greatly in demand. This demand, however, is too often the last resort. In too many instances the geologist is only permitted to serve as the oxygen-tank to the expiring enterprise.

Several years ago, but long after the principles of artesian water were well understood, one of our largest Southern cities hopefully sank what they expected to be an artesian well near the centre of the great granite laccolith upon which the city was built. Several years later the governing board of a leading university, ignoring its department of geology, which was kept in ignorance of the proceeding, spent a large sum of money sinking for artesian water in a glacial sand plain that lies on an impossible complex of ancient crystalline rocks. The humblest assistant in the department, receiving the princely salary of \$500 per annum, would have lost his position had he not known enough to avert such a loss of money if his advice had been asked.

In the coalfield of southern West Virginia, where the structure is unusually flat, a mining company wishing to open a coal seam on that side of the mountain opposite the place of discovery of the coal, sent their engineer with a wye level to run an exact level around the mountain.

After many days of cutting out thick underbrush the line was completed, an adit was made through the heavy talus, but no coal was found. A member of the U. S. Geological Survey came that way and discovered near the base of the mountain an excellent horizon-marker (a thin bed of fossiliferous limestone), which, traced around the mountain, revealed an unexpected flexure in the beds—a deformation entirely unsuspected by the engineer. In this instance the geologist accomplished in a few hours what the engineer had failed to do after several days.

The preventable waste in exploitation is enormous, even with the present inadequate technique of the geologist. Often do we find, for example, mountains and ridges shot through with barren tunnels for the purpose of tapping at great depths the downward extension of paltry outcropping veins at the top, which could have been proved worthless by a little serious work on the outcrop. Some of this waste can be charged to the over-enthusiastic and visionary prospector; some to the promoter who must have the appearance of important work continued so as to postpone the fatal day, while he sells stock; but much, unfortunately, is chargeable to organizations composed of men of honor and intelligence. Not only should this waste be stopped, but much of that which is now conceded to be unavoidable could also be prevented by improvement in the technique of geology through properly directed research; and this research to be effective must give careful attention to every minute detail.

PRELIMINARY FIGURES showing the production of quicksilver in the United States in 1920, compiled by F. L. Ransome, of the U. S. Geological Survey, Department of the Interior, give a total of 13,070 flasks. Of this output, 9366 flasks is credited to California, 3601 flasks to Texas, 79 flasks to Nevada, and 24 flasks to Oregon. So far as is known, neither Idaho nor Arizona produced any quicksilver. In California 10 mines were reported as productive; in Texas, 2; and in Nevada and Oregon, 1 each. In California, the New Idria, Cloverdale, New Guadalupe, Oceanic, Carson, and Oat Hill mines were closed during the latter part of the year, most of them with the expectation that work will be resumed when the conditions for mining and marketing quicksilver have improved. The largest producer, the New Idria, lost its reduction plant and a considerable quantity of quicksilver by fire on June 20. Operations were resumed at about half capacity in September, but ceased entirely in November. In Texas, the Chisos mine has been continuously productive, but the Big Bend was closed on the first of November. In Oregon, the War Eagle Mining Co. reports the completion of a 25-ton Scott furnace, which will not be placed in commission, however, under existing conditions. The year has been a discouraging one to quicksilver mine operators, who have had to face a decline in prices consequent upon a decreased demand for their product, and have found little relief from the prevailing high cost of labor and supplies. Such demand as there was for the metal has been met from surplus stocks.

Gold Mining at Kilo, in the Belgian Congo

*Statistics of gold output show declines in respect of 1920 in all the principal producing countries of the world. In some cases the value of output was larger in 1920 than in 1919 merely on account of the premium—the production in terms of ounces was less. Only one country that conducts gold-mining operations on any scale of magnitude recorded an improvement on the weight basis last year. This was the Belgian Congo, which for some time past has been unostentatiously building up a gold-mining industry and a gold-export trade. The Belgian Congo is generally associated in the minds of most people with the slave trade, red rubber, and the romance of ivory; or, in more recent years, with the development of the great Katanga copper belt and the peaceful exploitation under wise rule of a vast dependency rich in all manner of tropical produce; it is seldom associated with gold mining. Yet in its remote north-eastern corner there is a field which is already producing gold to the value of £400,000 per annum. The field in question is Kilo, situated to the west of Lake Albert Nyanza. The locality of Kilo, with reference to the great lakes, rivers, and transportation systems of the heart of Africa, is exhibited on a map that accompanies this article. Kilo is more or less of a mystery. Surprisingly little is known, but it is common knowledge that for the past fifteen years the Kilo and Moto mines have, under a form of state-owned proprietorship, been yielding substantial quantities of precious metal. The output was until lately exported via Lake Victoria Nyanza and the Uganda railway through Mombasa, but more recently the development of the Congo river route has induced the management of these properties to utilize that great waterway and to export by way of Boma.

It has not been the policy of the Congo government to induce diggers and prospectors to flock to this area. Neither has investigation or publicity been courted. It is, however, understood that the fields are extensive, that their producing potentialities are large, and that recently substantial quantities of heavy machinery have been dispatched to them.

The general geological features of this area are indicated by the presence of granite, with dikes of hornblende syenite, succeeded by hornblende syenite with granite dikes. At this point a vast area of micaceous schist commences, in which hornblende syenite occurs as bosses or dikes. Greenstone occurs to the eastward and includes diorite, amphibolite, soft hornblende, and chloritic rocks, some of which are schistose. Outcrops of quartz and quartzite are scattered throughout. Gold is found in the creeks and in the gravel of most of the valleys. Some of the chloritic schist shows iron pyrite much oxidized. A similar belt of greenstone rocks occurs farther south, where it is about 10 km. wide in an east-and-

west direction, granite occurring in the western portion and massive hornblende in the eastern. The belt widens out in a southerly direction; and there is little doubt that it represents a continuation of that found in the north. Reverting to that belt: in the neighborhood of latitude 1° north it has in its eastern portion an irregular area of massive fine-grained sandstone, with hard granite and quartz pebbles widely scattered. The same formation occurs again about 70 km. to the south-west, in the neighborhood of the Ibina river, and continues for 50 km. to the north, where it changes into coarse conglomerate sandstone, and this appears to be the northern limit of this sandstone. It extends, however, to the east in a somewhat circuitous course to about longitude 30° E., where black, dark, and gray shales, slates, and argil-



laceous sandstones are found. The width north and south of the sandstone probably does not exceed 20 km. The adjoining rocks are granite and coarse-grained hornblende.

The question of transport in this part of the world is naturally of vital importance, and several schemes for improving communication are now under consideration. A new motor-car route—Redjaf (on the Nile), Abbas, Faradje, Nzoro River, Moto gold mines—will be completed in about six months. The route is already open to traffic up to the Nzoro river. By contract with the mines management, a Greek firm is maintaining a regular motor service on the route, which is, however, built for light traffic only. The route from Kaseny (on Lake Albert) to Kilo, built for heavy traffic, is not yet completed.

At present the state-owned gold mines of the Kilo and Moto countries produce, roughly, 3000 kilogrammes of gold yearly; and the Senguli mines (belonging to the Kassai company and situated also in the north-east Congo) produce 2 to 3 kilogrammes of gold monthly. When heavy machinery can be sent there the outputs will be increased. In the meantime the Kassai company is prospecting extensively. The Forminiere company is understood to be about to resume the working of its Tele gold mines. Even in this part of the world, industry is not free from strikes, and recently the Brussels 'Nation Belge' published a cable from Redjaf stating that the white staff of the Moto gold mines threatened a strike as a protest against recent measures taken by the management.

*Abstracted from the 'S. A. Mining and Engineering Journal'.

Company Reports

JIM BUTLER TONOPAH MINING COMPANY

Report for the year ended December 31, 1920.

Property: Mines at Tonopah, Nevada.

Operating Officials: F. Bradshaw, general superintendent; L. R. Robins, mining engineer.

Financial: Net profit, \$16,865.26.

Development: 1249 feet.

Ore-Reserves: Practically exhausted.

Production: 12,515.8 tons of gross value of \$263,658.44.

MYSORE GOLD MINING COMPANY, LTD.

Report for the year ended December 31, 1920.

Property: Mines and plant at Kolar, Mysore, India.

Operating Official: R. H. P. Bullen, superintendent.

Financial: Total receipts, £777,130 1s. 5d.; expenditure, £493,746 8s. 1d.; profit, £283,383 13s. 4d.

Dividends: £39,926 8s. 4d. and £106,249 3s. 5d.; to date £8,994,019 13s. 11d.

Production: 233,503 tons was milled, producing by amalgamation and cyanidation, 156,759 oz. gold of a realized value of £808,182 17s. 8d.

OLD DOMINION COMPANY

Report for the year ended December 31, 1920.

Property: Mines, mill, and smelter in Arizona.

Operating Officials: W. G. McBride, general manager; I. H. Barkdall, mine superintendent; H. H. Colley, smelter superintendent.

Financial: From sales of copper, silver, and gold, \$5,548,-177.28; less, \$308,165.19.

Development: 31,626 feet.

Production: 249,111 tons for a yield of 22,854,452 lb. copper; 181,010 oz. silver; and 3484 oz. gold.

General: The end of the year found the mine in excellent condition; the increase in ore-reserves has been encouraging. There is no indication of a decrease in the extent of the orebodies in depth.

MOUNT BISCHOFF TIN MINING COMPANY

Half-yearly report for period ended December 31, 1920.

Property: Tin-bearing lands at Waratah, and plant at Launceston, Tasmania.

Operating Officials: C. W. Gudgeon, general manager; F. B. Jackson, smelting manager.

Financial Statement: Total credit for the half year, £78,067 8s. 6d.; credit to profit and loss account, £71,017 19s. 10d.

Dividends: £4500.

Development: 1483 ft.; ore-reserves, positive, 253,850 tons, containing 0.353% tin.

Production: 54,199 tons was crushed; oxide output, 226½ tons; smelted, 1852 tons; yield, 1256½ tons of tin, of 99.89% grade.

NORTH STAR MINES COMPANY

Report for the year ended December 31, 1920.

Property: Mines and mill in California.

Operating Official: A. B. Foote, general superintendent.

Financial: Total production, \$821,129.50; expense, \$744,-995.31; operating profit, \$76,134.19; after adding interest and dividends, and deducting amount for depreciation and depletion, there was a net deficit of \$51,415.19. A dividend of \$75,000 was declared as a distribution of capital assets.

Development: North Star mines, 7285 ft.; Champion mines, 304 feet.

Production: North Star mines, 61,400 tons for an average yield of \$11.70 per ton; 80.61% was recovered by amal-

gamation and 19.39% by cyanidation. Champion mines, 17,626 tons for an average yield of \$5.84 per ton.

SILVER KING CONSOLIDATED MINING COMPANY OF UTAH

Report for the year ended December 31, 1920.

Property: Mines in Utah.

Operating Officials: S. Spiro, general manager; H. A. Lee, assistant manager.

Financial: Receipts, including ore sales, convertible notes, bills payable, sale of second-hand machinery, subscription, and miscellaneous, \$220,888.94; disbursements, \$216,-052.83. An assessment of 10 cents per share was levied on all the issued and outstanding shares of the capital stock, to be paid on or before May 16, 1921.

Production: 438 tons, sold for \$26,304.72.

Development: The heading of the Spiro tunnel has been advanced 2487 ft., and the ditch at the side, 1632 ft. In addition, 96 ft. of cross-cuts and 255 ft. of raises has been driven.

CHAMPION REEF GOLD MINING COMPANY OF INDIA, LTD.

Report for the year ended September 30, 1920.

Property: Kolar field, Mysore, India.

Operating Officials: John Taylor & Sons, general managers; C. F. Heathcote, superintendent.

Financial Statement: total income, £362,542 8s. 4d.; working costs, £295,966 19s. 7d.; profit, £66,575 8s. 9d.

Dividends: January 29, 1921, £34,666 13s. 4d.; to date £4,616,966 8s. 6d.

Development: 9281 ft., as against 8702 ft. in previous year. Reserves, 248,846 tons, a reduction of 44,669 tons.

Production: 79,274.1 oz. gold from 143,386 tons of ore, 48,965 tons of old tailing, and 2166 tons of accumulated slime.

SHATTUCK ARIZONA COPPER COMPANY

Report for the year ended December 31, 1920.

Property: Bisbee, Cochise county, Arizona.

Operating Officials: L. C. Shattuck, general manager; A. Houle, superintendent.

Financial Statement. Gross income, \$1,582,923.71; total expense, \$1,609,871.69; loss, \$26,947.98; net loss for year carried to profit and loss, \$239,115.17; balance on December 31 in surplus account, \$318,556.61.

Development: 8250 feet.

Production: Ore smelted and treated, 19,175 tons copper, and 93,061 tons lead; for a production of 2,374,148 lb. copper, 4971 oz. gold, 401,626 oz. silver, and 8,279,678 lb. lead.

CALUMET & HECLA MINING COMPANY

Report for the year ended December 31, 1920.

Property: Mines and mills in Michigan.

Operating Officials: J. MacNaughton, general manager; W. M. Gibson, assistant superintendent; J. Knox, chief mining captain; E. S. Grierson, chief engineer.

Financial: Total production cost, \$6,117,579.13; net loss, \$3,823,743.18; dividends paid, \$500,000.

Production: 57,627,883 lb. copper; the re-grinding plants treated 540,327 tons from the mine for a recovery of 4.11 lb. copper per ton, and 777,538 tons from old sands, for a recovery of 6.03 lb.; the leaching-plant treated 1,333,780 tons for a recovery of 8.16 lb. per ton; the flotation plants treated 705,747 tons for a recovery of 6.43 lb. per ton; and the reclamation plant treated 1,378,500 tons for a recovery of 10.26 lb. copper per ton.

General: During the year the last of the round slime-tables were replaced by Wilfley tables, and the Chilean mills are to be replaced by Hardinge mills. The Tamarack mill has been dismantled. Foundations for a new reclamation

plant near the site of the old Tamarack mill, and steel for the building, are under contract for delivery. A dredge for this plant has not yet been ordered. The plant will be used for re-treating the Tamarack conglomerate sands, of which there is about 12 million tons.

UTAH COPPER COMPANY

Report for the last quarter of 1920.

Property: Mines and mills in Utah.

Operating Officials: R. C. Gemmell, general manager; L. S. Cates, assistant general manager; J. D. Shilling, superintendent of mines; D. D. Moffatt, consulting engineer of mills; F. G. Janney, general superintendent of mills; H. C. Smith, superintendent Magna plant; T. A. Janney, superintendent Arthur plant; H. C. Goodrich, chief engineer.

Financial Statement: Net income (deficit) \$589,514.92. Net deficit for the year, \$4,722,441.62.

Dividends: \$2,436,735.

Production: 23,921,581 lb. of copper in concentrate, and 1,157,562 lb. in precipitates from leaching-plant. To produce this, 1,347,000 tons of ore was milled, of an average grade of 1.1115%. The average extraction was 79.89%.

SUPERIOR & BOSTON COPPER COMPANY

Report for the fiscal quarter ended December 31, 1920.

Property: Mines at Globe, Arizona.

Operating Officials: E. G. Deane, general manager; C. W. Botsford, geologist.

Development: 2122 ft. underground, as compared with 2218 ft. during the previous quarter; 1036 ft. of diamond-drilling, as compared with 1496 ft. during the previous quarter.

Production: 4600 tons of ore, producing \$34,589.33 in net smelter returns.

General: In a supplementary report dated February 1, 1921, it is stated that in the request for further funds for development (50 cents per share), the chief consideration was the desirability of an early determination of the merits of the property, a considerable portion of which remains unexplored.

CALLAHAN ZINC-LEAD COMPANY

Report for the year ended December 31, 1920.

Property: mines and mills at Interstate, Idaho.

Operating Officials: C. W. Newton, manager; J. B. Parker, metallurgical engineer.

Financial: total operating income, \$1,424,530.06, as compared with \$494,263.63 in 1919; expenditures, \$1,158,282.33; net profit, \$266,247.73; proceeds from sale of stocks, \$171,062.10; surplus, \$437,309.83.

Dividends: \$755,606; to date, \$7,721,688.75.

Production: 128,781 tons was milled. Shipment contained 2,047,388 lb. lead, 29,845,344 lb. zinc, and 237,523 oz. silver.

General: During the year the company has acquired a controlling interest in the Chicago-Boston Mining Co. and also in the Killbuck Mining Co., both of which are silver-lead producers.

AMERICAN ZINC, LEAD & SMELTING COMPANY

Report for the year ended December 31, 1920.

Property: Mines, mills, and lead-smelter in Missouri; smelter in Kansas; controls the American Zinc Co., of Tennessee, and other concerns.

Financial: Total loss for the year, \$132,034.42; surplus at December 31, 1920, \$2,677,195.21.

Dividends: \$482,037.

General: At the Mascot mine the development during the year added as much ore as was extracted, so that ore-reserves were maintained. The company's Missouri mines have been closed down until conditions improve. The company has, during the past year, diversified its activities, so

that its earnings are not, as before the War, principally dependant on the zinc-slab business. The plants are technically efficient, and operations are in shape for quick expansion as conditions warrant.

UTAH CONSOLIDATED MINING COMPANY

Report for the year ended December 31, 1920.

Property: Mines in Utah.

Operating Official: F. Cowans, general manager.

Financial: Receipts from sales of metals, less decrease in value during year, \$1,529,749.12; rentals, interest, and dividends, \$82,079.68; net loss, \$196,140.08.

Development: 10,412 ft.; ore-reserves, 815,000 tons averaging 1.96% copper, 0.57 oz. silver, and 0.04 oz. gold.

Production: 102,174 tons of ore, shipped to smelters, yielding 3,187,492 lb. copper, 9,999,350 lb. lead, 273,730 oz. silver, and 4697 oz. gold.

General: A mill with a capacity of 1000 tons per day has been built at International, Utah, and will be ready for operation in April. Decisions in the litigation with the Utah Apex Company were adverse to the company. An accounting of \$659,000 has been filed with the court, covering the value of the ore extracted from this territory, for which the company will have to pay if the decisions are confirmed. None of the company's principal copper orebodies are involved in this litigation.

AMERICAN SMELTING & REFINING COMPANY

Report for the year ended December 31, 1920.

Properties: United States, Mexico, and South America.

Operating Officials: Globe plant, Denver, Colorado, W. F. De Groot, superintendent; Pueblo plant, Pueblo, Colorado, F. G. Hills, superintendent; Arkansas Valley plant, Leadville, Colorado, E. P. Chapman, superintendent; Durango plant, Durango, Colorado, R. P. Reynolds, superintendent; Blende plant, Pueblo, Colorado, J. D. Thomas, superintendent; Murray plant, Murray, Utah, W. W. Norton, superintendent; Garfield plant, Garfield, Utah, A. H. Richards, manager; El Paso plant, El Paso, Texas, N. A. Ferguson, business manager; Hayden plant, Hayden, Arizona, H. A. Eye, manager; Perth Amboy plant, Maurer, New Jersey, J. F. Austin, manager; Baltimore plant, Baltimore, Maryland, W. H. Pierce, general manager; Federal plant, Federal, Illinois, R. Porter, manager; Sand Springs plant, Sand Springs, Oklahoma, F. P. Lannon Jr., general superintendent; Henryetta plant, Henryetta, Oklahoma, C. E. Gregg, superintendent; Omaha plant, Omaha, Nebraska, R. F. McElvenny, manager; Selby plant, San Francisco, California, E. B. Braden, general manager; Tacoma plant, Tacoma, Washington, H. Y. Walker, manager; East Helena plant, East Helena, Montana, C. W. Adams, manager; Kusa plant, Kusa, Oklahoma, C. W. Morrison, superintendent; Monterrey plant, Monterrey, N. L. Mexico, L. B. Harrison, superintendent; Chihuahua plant, Chihuahua, Mexico, J. R. Enlow, superintendent; Aguascalientes plant, Aguascalientes, Mexico, F. H. Peyton, superintendent; Matehuala plant, Matehuala, S. L. P., Mexico, R. T. Wilder, superintendent; Asarco plant, Velardena, Durango, Mexico, G. P. Robinson, superintendent.

Financial Statement: Gross income, \$15,747,715.27; charges, \$9,072,936.57; net income for the year, \$6,674,778.70; income credit balance transferred to profit and loss, \$12,721.45.

Dividends: \$6,662,057.25.

Production: gold, 1,849,048 oz.; silver, 77,732,911 oz.; platinum and palladium, 936 oz.; lead, 205,249 tons; copper, 590,850,000 lb.; spelter, 44,106,253 lb.; nickel, 375,167 lb.; tin, 18,511,160 lb.; sulphuric acid, 51,688,000 lb.; arsenic, 17,695,266 lb.; copper sulphate, 3,618,172 lb.; by-product metals, 1,549,426 lb.; sulphur di-oxide, 8,154,734 pounds.

Book Reviews

The Electric Furnace. By Henri Moissan. Translated by Victor Lehner. Second edition. 308 pp., ill., index. For sale by 'Mining and Scientific Press'. Price, \$3.50.

This is a manual for the chemist, who either is making, or who could make, use of the electric furnace in his investigations. For such an investigator the book will be indispensable. It deals primarily with the theoretical, and only incidentally with the commercial side of the electric furnace.

Organic Chemistry for the Laboratory. By W. A. Noyes. 8vo., cloth. Chemical Publishing Co., Easton, Pa. For sale by 'Mining and Scientific Press'. Price, \$3.50.

This is a new edition, the fourth, of what is considered by many as an excellent treatise on laboratory work in organic chemistry. The object has been to furnish the beginner with full and accurate directions for the procedure to be taken, and clear and concise explanations of the processes and tests. The second object has been to provide, for the more advanced student and worker, a guide that will aid him in the selection of processes likely to be successful in the preparation of compounds. The author is the professor of chemistry at the University of Illinois.

Geology of Petroleum. By W. H. Emmons. 563 pp., ill., index. McGraw-Hill Book Co., Inc., New York. For sale by 'Mining and Scientific Press'. Price, \$6.

This book will be useful primarily as a textbook for students, but will also be of service to the practising geologist as a foundation for the study of any particular field that happens to be new to him. The first third of the book is devoted to a general discussion of the various geological phenomena affecting the accumulation of petroleum, as well as the interpretation of surface and other indications. The remainder of the book is devoted to a brief survey of the principal features of the various known fields throughout the world.

Copper Refining. By Lawrence Addicks. 206 pp., 6 by 9 in., ill. McGraw-Hill Book Co., New York. For sale by 'Mining and Scientific Press'. Price, \$3.

The various chapters in this book appeared as a series of articles in 'Chemical and Metallurgical Engineering'; they are written by an engineer of high standing; the book will be of value to all who are interested in the electrolytic refining of copper. The subjects dealt with are as follows: metal losses, metals in process, tank resistance, current density, current efficiency, impurities, by-products, furnace refining, the requirements of refined copper, copper from secondary material, the power problem, elements of design, and the application of electrolytic refining to other fields.

Mining Manual and Mining Year Book, 1921. Compiled by Walter R. Skinner. For sale by Walter R. Skinner, 11 Clements Lane, London, E.C. 4, and from 'Financial Times'. 72 Coleman St., London, E.C. 2. Price 20s.; post free inland 21s.; post free abroad 21s. 6d.

This indispensable adjunct to the library of those interested in mining makes its thirty-fifth annual appearance. It contains particulars of 1430 mining companies—gold, diamond, silver, copper, tin, iron, and coal. The particulars given include the names of the directors and other officials, the date of establishment, the seat of operations, a description of the property with the purchase price, plant erected or in course of erection, present working results, ore-reserves, details of capital, calls, dividends paid, and the financial position as disclosed by the latest accounts. Highest and lowest prices of the shares for the last three years

are also given. The book contains the names of 3530 directors and 952 mining and consulting engineers and their addresses. Other useful features are the supplementary index of dormant companies which have ceased to be of public or market interest; crushing tables and outputs from the principal gold mines, showing tons treated monthly, results obtained, and yield per ton; annual yields; and dictionary of mining terms.

Cam Design and Manufacture. By F. B. Jacobs. 118 pp., ill., index. D. Van Nostrand Co., New York. For sale by 'Mining and Scientific Press', 420 Market street, San Francisco. Price, \$2.

The principal object of this book is to explain how to lay out and cut cams without having to resort to complicated formulas. The author begins with a general description of the various types of cams employed in machine design. He then gives directions for the laying out of cams. The subject of cam-curves is then discussed, and then follows a chapter on master-cams. The chapters on cutting and grinding cams are illustrated with actual examples from production work. The book is well-illustrated and will be useful to anyone engaged in machine design.

Inorganic Chemistry. By J. L. Howe. 8vo., cloth. Chemical Publishing Co., Easton, Pa. For sale by 'Mining and Scientific Press'. Price, \$4.

This treatise, which is the second revision of Venable and Howe's 'Inorganic Chemistry', is a text-book of elementary chemistry for beginners, or for those who have had, at the most, a high-school course in chemistry only. Like Sir William Ramsay's 'System of Inorganic Chemistry' it takes the Periodic System as the guiding principle in the arrangement of topics. The author, who is professor of chemistry at the Washington and Lee University, has proved the worth of the system over a period of 12 years, and has found it successful. This new edition will find a place among standard text-books on the subject.

Export Packing. By C. C. Martin. 723 pp., ill. Published by the 'American Exporter', New York. For sale by 'Mining and Scientific Press'. Price, \$10.

The appearance of this book is justified by the scant attention paid by many firms to the importance of adequate and scientific packing for export. Efficient methods for all classes of commodities are described, illustrated by photographs. Information is given on foreign custom-house regulations, together with tariff provisions that affect packing. A great deal of other information of interest and value to exporters is contained in the volume; the prevention of pilfering is dealt with; and there is a chapter on parcel-post shipments. A study of the book will help to remove one of the minor impediments to success in connection with trade expansion abroad.

Automotive Ignition Systems. By Earl L. Consoliver and Grover I. Mitchell. 262 pp., ill., index. McGraw-Hill Book Co., Inc., New York. For sale by 'Mining and Scientific Press'. Price, \$2.50.

Although this book has been prepared primarily with the needs of the repair-man and the factory worker in mind, a study of it will well repay any motorist that is willing to take a little time and trouble in order to arrive at a better understanding of the ignition system of his car. The scope of the book can be judged from the chapter-headings, which are: Principles of Electricity and Magnetism; Ignition Batteries; The Jump-Spark Ignition System; Modern Battery Ignition Systems; Battery Ignition Systems for Multiple Engines; The Low-Tension Magneto; Modern High-Tension Magnetos; Care and Repair of Ignition Apparatus; Ignition Troubles and Remedies. Ignition systems for aeroplanes,

trucks, and tractors as well as for automobiles are discussed. Generous use is made of both photographs and line-drawings to assist the reader in following the text. The discussion throughout is as nearly non-technical as it is possible to make it, and can be understood readily by anyone with even a slight knowledge of the rudiments of electricity.

Further Light on the Theory of the Conductivity of Solutions. By Guy Clinton. Paper. Chemical Publishing Co., Easton, Pa. For sale by 'Mining and Scientific Press'. Price, 50 cents.

This pamphlet has been published to justify the conclusion reached by the author that Kohlrausch's law of ionic movements is not in harmony with Faraday's law of discharge. It is maintained that, in the early fraction of the electrolysis, in parts of the cell remote from the point of discharge, the sum of the velocities of the anion and the cation is proportional to the molecular conductivity of the solution. The effect of hydration of ions is examined; and it is pointed out that previous work has not taken into account the eddies formed in such a system. Electrophoresis is thought to be due to the passing of hydrated ions through a membrane that hinders the movements of the returning currents.

Field Methods in Petroleum Geology. By G. H. Cox. C. L. Dake, and G. A. Mullenburg. 294 pp., ill., index. McGraw-Hill Book Co., Inc., New York. For Sale by 'Mining and Scientific Press'. Price, \$4.

The distribution of space in this book is as follows: An introductory chapter of 12 pages, mainly on the accumulation of oil, such material as may be found in any book on economic geology. Two chapters, containing 116 pages in all, on instruments required in topographic surveying and their uses, material such as may be found in any book on topographic surveying. A chapter of 38 pages on identification of structure, material also available in books on economic geology. A chapter of 36 pages devoted mainly to ordinary field methods of topographic surveying. A 30-page glossary and 64 pages of the ordinary mathematical tables. Nearly everyone that would find this book of value already has some good book on economic geology and some good book on topographic surveying. It may have been worth while to combine certain features to be found in such books in one volume. We doubt it.

Recent Publications

Report of the Governor of Alaska to the Secretary of the Interior, 1920. 132 pp., map.

World Atlas of Commercial Geology. Part I. Distribution of Mineral Production. U. S. Geological Survey, 1921. 72 map-plates.

Chromite in 1919. By J. S. Diller. I:8, U. S. Geological Survey, 1921. 4 pp. From Mineral Resources of the United States, 1919, Part I.

Commercial Minerals of California. By W. O. Castello. Bull. No. 87, California State Mining Bureau, San Francisco, 1920. 124 pp., index.

Phosphate in Canada. By Hugh S. Spence. No. 396, Mines Branch, Canada Department of Mines, Ottawa, 1920. 156 pp., ill., map, index.

The Geology and Ore Deposits of Ely, Nevada. By Arthur C. Spencer. Prof. Paper 96, U. S. Geological Survey, 1917. 181 pp., ill., index, plates.

Secondary Metals in 1919. By J. P. Dunlop. I:7, U. S. Geological Survey, 1921. 35 pp. From Mineral Resources of the United States, 1919, Part I.

Foreign Graphite in 1919. By Arthur H. Redfield. II:12,

U. S. Geological Survey, 1921. 30 pp. Mineral Resources of the United States 1919, Part II.

Phosphate Rock in 1919. By Ralph W. Stone. II:13, U. S. Geological Survey, 1921. 15 pp. Mineral Resources of the United States, 1919, Part II.

Sand-Lime Brick in 1919. By Jefferson Middleton. II:15, U. S. Geological Survey, 1921. 2 pp. From Mineral Resources of the United States, 1919, Part II.

Fuller's Earth in 1919. By Jefferson Middleton. II:17, U. S. Geological Survey, 1921. 8 pp. From Mineral Resources of the United States, 1919, Part II.

California Mineral Production for 1919. By Walter W. Bradley. Bull. No. 88, California State Mining Bureau, San Francisco, 1920. 204 pp., ill., maps, index.

Gems and Precious Stones in 1919. By B. H. Stoddard. II:11, U. S. Geological Survey, 1921. 16 pp. From Mineral Resources of the United States, 1919, Part II.

Bibliography of Petroleum and Allied Substances in 1918. By E. H. Burroughs. Bull. 189, Petroleum Technology 58, U. S. Bureau of Mines, 1921. 180 pp., index.

Potash Resources of Nebraska. By W. B. Hicks. Bull. 715-I, U. S. Geological Survey, 1921. 15 pp. From Contributions to Economic Geology, 1920, Part I.

The Divide Silver District, Nevada. By Adolph Knopf. Bull. 715-K, U. S. Geological Survey, 1921. 24 pp. From Contributions to Economic Geology, 1920, Part I.

Abstract of Current Decisions on Mines and Mining, Reported May-August, 1919. By J. W. Thompson. Bull. 183, Law Serial 20, U. S. Bureau of Mines, 1920. 167 pp.

Magnesite in 1919. By Charles G. Yale and Ralph W. Stone. II:14, U. S. Geological Survey, 1921. 11 pp. From Mineral Resources of the United States, 1919, Part II.

The Clay Industry in California. By E. S. Boalch and Others. Preliminary Report No. 7, California State Mining Bureau, San Francisco, 1920. 102 pp., ill., index, map.

Quality of Gasoline Marketed in the United States. By H. H. Hill and E. W. Dean. Bull. 191, Petroleum Technology 59, U. S. Bureau of Mines, 1920. 275 pp., index.

Report on Road Materials Along the St. Lawrence River, from the Quebec Boundary Line to Cardinal, Ontario. By R. H. Picher. Bull. No. 32, Mines Branch, Canada Department of Mines, Ottawa, 1920. 65 pp., ill., map.

Phosphate Rock near Maxville, Granite County, Montana. By J. T. Pardee. Bull. 715-J, U. S. Geological Survey, 1921. 5 pp., map. From Contributions to Economic Geology, 1920, Part I.

The Mogollon District, New Mexico. By Henry G. Ferguson. Bull. 715-L, U. S. Geological Survey, 1921. 34 pp., maps, plates. From Contributions to Economic Geology, 1920, Part I.

Coal in 1918. Part B. Distribution and Consumption. By C. E. Leshner. II:35, U. S. Geological Survey, 1920. 78 pp., map. From Mineral Resources of the United States, 1918, Part II.

The Geology and Mineral Resources of Medina County. By R. A. Liddle. University of Texas Bull. No. 1860, October 25, 1918. University of Texas, Austin, Texas. 177 pp., ill., index, map.

Preliminary Report on the Mineral Production of Canada During the Calendar Year 1920. Prepared by John McLeish. No. 554, Mines Branch, Canada Department of Mines, Ottawa, 1921. 24 pp.

The Mineral Industry of the British Empire and Foreign Countries. War Period. Anthimony (1913-1919). Imperial Mineral Resources Bureau, London, England, 1921. 34 pp. H. M. Stationery Office, Imperial House, Kingsway, London, W.C. 2, England. Price 1s. net.

REVIEW OF MINING



A. S. & R. REDUCES EXPENSES

The American Smelting & Refining Co. has been having its annual meeting of plant managers in New York for an interchange of views. The payroll has been reduced fully \$3,000,000, including salaries of executives and clerical forces as well as laborers' wages. In this estimate no account has been taken of the men dropped entirely. Paring costs to the bone has been undertaken; when renewed demand for metals necessitates increased operation it will be on a basis much below costs for the past year or two. None of the plants in the United States has been closed down. In Mexico, the Asarco smelter has been idle for some time with no present intention of resuming. The Chihuahua smelter has one or two units in operation; the Aguas Calientes and Matehuala plants will govern their operations by the amount of ores offering for treatment. In South America neither the Carrizal nor the Caldera plant, both in Chile, has operated for some time. The Perth Amboy copper refinery has been closed for some months, although it has been running its converter and shipping the blister-copper to the Baltimore refinery. The Tacoma refinery has also been treating Kennecott ores and some concentrate from Garfield. All three of the larger copper smelters will probably be running for the next 60 or 90 days in cleaning up the mine products shipped them by custom properties, including the Garfield, Hayden, and El Paso plants. Lead operations have been reduced materially. The East Helena plant has halved its activities from four to two furnaces; the Murray lead smelter has dropped from 8 to 3 units; the El Paso lead plant has but one of its three furnaces running. The Selby lead refinery has been running full blast, as the output from that source contains silver from domestic ores, which the company sells at \$1 per ounce to the United States government. The zinc end of the A. S. & R. Co.'s business has collapsed with all five of its smelters closed tight. The company has, however, found a new source of revenue in the manufacture of zinc oxide which it turns out at its Blende zinc smelter.

MINING EXPOSITION AT CHICAGO

The 24th annual convention and exposition of mines and mining equipment, under the auspices of the Mining Congress, will be held at the Coliseum, Chicago, during the week of October 17. Those who are interested should communicate with John T. Burns, the assistant secretary, American Mining Congress, Congress Hotel, Chicago.

THE SLUMP IN DIAMONDS

Owing to the seriously depressed state of the diamond market, the diamond mines in South Africa have found it necessary to restrict production in every possible way, states a consular report. The De Beers Mines at Kimberley have reduced their white employees by 500, the Premier Mines in the Transvaal have retrenched to the extent of dispensing with the services of 250 of their white employees, and the Wesselton mine has closed down entirely until such time as the state of the market will again justify operations. Many residents of European countries, being hard pressed for money, have been obliged to sell their heirlooms; these cut

stones have been and are changing hands today at prices far below those at which it is possible to produce the uncut article. The reduced production of diamonds is also severely felt by the South African government, which derives a large revenue from the sale and export of these stones.

ALASKA

Dawson.—A 9-ft. silver vein in the Rico claim in the Mayor district is reported. The strike was made in a tunnel which pierces a 1000-ft. bluff and in the centre of the vein is said to be two feet of galena, assaying more than \$200 per ton.

ARIZONA

Bisbee.—The Copper Queen and the Calumet & Arizona Mining companies have announced further reductions of 25 to 60c. per day in wages for mine workers effective May 1. All salaried employees of the companies are to be reduced to a figure that will be 5% above base pay. At the beginning of this year the salaries paid were 37½% above base pay. Miners are now getting \$5.10, and muckers \$4.60 per day. About 1500 men will be affected by the change.

Jerome.—It is reported that the shaft of the Shea mine, 110 ft. below the 320-ft. tunnel level, is practically all in ore that will average \$22 per ton, most of which is silver and gold. This ore that was encountered 20 ft. above appears to be dipping vertically; the vein averages 4½ ft. wide.

Kingman.—The Arizona Mossback Mines Co. has purchased several groups, totaling 45 claims, and three water rights from Charles H. Burlock and associates. These groups, the National Five Gold Mines Co., the Black Horse Mines, and other smaller ones, for the most part adjoin the Arizona Mossback property. The company is planning to dam Cottonwood creek; this will give sufficient water for milling purposes and some power. The price paid for the National Five Gold Mines property is said to be \$150,000. Mr. Burlock sold the Mossback mine to the Arizona Mossback Mines Co. in 1917. He and his associates have held these claims for twenty years.

Outman.—It is announced that the directors of the United Eastern Mining Co. have decided to sink an 800-ft. shaft on its property to the west of the Red Cloud claim of the Tom Reed Gold Mines Co. and in which a rich body of ore is said to have been opened on the 650-ft. level. The United Eastern is enlarging the Big Jim shaft from the 400-ft. level to the surface, and preparations are being made to unwater the mine to the 600-ft. level, from which point further development is to be carried on. It is expected that the increased development work will add considerably to the number of men employed by the United Eastern.

Lessees of the Mayflower mine of the Gold Reed holdings have opened ore assaying \$60 to \$100 per ton at the 60-ft. level. Some years ago the Gold Reed company sunk a 600-ft. shaft that cut the vein, but the management failed to follow the ore.

CALIFORNIA

Amador City.—J. W. Preston, representing the Mary Ives Crocker estate in the Volcano district, states that the company intends to operate the property in the near future.

The ditch capacity will be doubled this summer. Announcement that a vein of high-grade ore from eight to fifteen inches thick has been discovered in the 2600-ft. level of the Bunker Hill mine is made by directors of the company. The vein was found in a lode of good milling ore from 10 to 15 ft. wide. Coming at a time when the owners of the mine had been seriously considering curtailing operations, the discovery will have the effect of stimulating activity.

Grass Valley.—Owing to the failure of the transformers and current supply for the electric pumps, more than 3600 ft. of cross-cuts and shafts filled with water at the Allison Ranch mine recently. It was necessary to pull the pumps from the lower workings, but none of the levels where work is being carried on was reached by the water. The trouble was finally overcome by the installation of transformers from the Champion mine, Nevada City.

Igo.—The recent strike of silver ore in the Chicago mine near here has increased in importance. In two weeks work the vein has widened from 14 to 36 in. The drift has been 180 ft. on the lode.

Nevada City.—Work has been resumed on the Twin Sisters mine, Snow Point.

Redding.—The Mountain Copper Co. and Balaklala Copper Co. filed suits in the U. S. Court in Sacramento against Shasta county to recover taxes, paid under protest in 1920. The first company wants \$11,461 returned and the second, \$8185.68. The Mountain Copper Co. holds that its Iron Mountain was assessed at \$549,000, though it protested at the time that \$112,300 was a fair assessed valuation on a 50% basis. The Balaklala mine was assessed for \$262,160, which was \$218,285 too much, according to the company's complaint. The Mountain Copper Co. recently won a similar case in the U. S. Court, involving taxes paid under protest in 1919. The county has appealed this case to the U. S. Circuit Court.

COLORADO

Aspen.—Reports are current that the Empire Zinc Co. is negotiating control of the Mollie Gibson and Smuggler mines.—Boilers, compressor, and machine drills have been purchased in Denver for the Aspen Silver Lead Mines Co. for use on its Porphyry Mountain properties.

Blackhawk.—The Silver Mountain Mining Co. has started drifting at a depth of 260 ft. on a vein carrying native silver. High-grade ore has been produced from other properties in this section.—The ore-shoot on the Alaska mine of the Midwest Mining Co. has been proved for better than 75 ft., with rich ore sampling as high as 300 oz. silver still showing in the breast. The force has been increased, and shipments of 200 tons daily will soon be made. On the Peru claim of the Cyclops group, more than 50,000 tons of ore running \$35 to \$40 per ton is reported blocked out. The company's mill is nearing completion, and in the meantime the old mill is operating and concentrate is being shipped to the smelter.

Central City.—The Sherman and Macon Mining Co. plans the erection of a power plant, and the development of its Silver Creek properties by tunnel extension. The present tunnel is 1500 ft. long, and has cut mineralized veins not yet prospected.—The J. J. McCreer Co. has resumed operations on its Deer Creek property. Two shifts are employed in the tunnel, breaking ore for shipment.

Cripple Creek.—The C. O. D. mine, originally owned by the Rebecca G. M. Co., has been leased for 2½ years to H. P. Reiton, Cripple Creek operator, and work has been resumed through the main 3-compartment shaft.—The Queen Bess and Mollie Kathleen properties at Tenderfoot hill, have been leased to Colorado Springs operators and will be worked through the Mollie Kathleen shaft.—The Ella W., another Tenderfoot Hill mine, is again producing ore.—The Port-

land company is reported as planning the sinking of the No. 2 or main shaft an additional 300 feet.

Georgetown.—The Silver Plume Con. Mining Co. is mining lead-silver ore in its Hanna Mountain tunnel.—Lessees of the Scepter mine have exposed 12 in. of vein sampling 116 oz. silver to the ton. Ore is being saved for shipment while development continues.—The Hurlough mill, recently remodeled, is treating 75 tons daily; the saving is reported satisfactory.

Silverton.—Clear title has been secured by the San Juan Golden Fleece Mining Syndicate to the old Golden Fleece on Treasure mountain, 16 miles north of Silverton; arrangements have been made for a resumption of work.

IDAHO

Coeur d'Alene.—A strike in the Pine Creek district was made recently on the Sydney group, adjoining the Nabob property, seven miles south-east of Kellogg. The ore carries lead and zinc and a small amount of silver. The Sydney group comprises 18 claims on Pine creek, six miles from the railroad. A short tunnel was driven in the upper workings and a 10-ft. vein was exposed. On a lower level a tunnel and 526 ft. of cross-cutting was done and a 25-ft. vein was struck at a depth of 400 ft. from the surface. From this level a winze was sunk through eight feet of milling ore. The present strike was made while drifting along the McDougal fault at the intersection of the two veins on the property. The officers and directors are L. W. Gay, president; Charles Gloystein, vice-president; W. T. Simons, secretary and treasurer. These officers, with L. M. Gay and Evans Gay, form the directorate.

The Bullion Mining Co. will resume operations as soon as weather permits. Work will be done in both the east and the west drifts. In the east drift the work is in ore and in the west drift it will follow the dike until the vein is picked up.—The Giant Mining & Development Co., with a property in the Sunset district, reports the south drift being carried on for 500 ft. and now almost under the vein on the surface. Owing to the dip of the vein the drift must continue considerably further before the vein is cut, but it is believed this will be done within the next 100 ft.—Work will be resumed in the near future with a small force by the Spokane Tunnel Co. at its property on Placer creek. The company has a 25-ft. vein carrying about 40% iron. The main tunnel is more than 900 ft. long.—During the week ended April 15, the Bunker Hill & Sullivan smelter shipped 75,000 oz. of silver to the U. S. Mint at Denver. This is the second large shipment of silver during the last two weeks. The smelter is operating one furnace and handling 100 tons of ore per day, which comes from the Hecla, Caledonia, Bunker Hill & Sullivan mines, and a few lessees on Big creek.

The Sunshine Mining Co. has a considerable amount of ore with a high content of silver; assays on shipments recently made to the Bunker Hill & Sullivan and East Helena smelter ran between 113 and 146 ounces per ton. The mine is shipping three cars of high-grade ore per month, and returns from a 20-ton car shipped to the Bunker Hill smelter netted \$1139. New bins have been built at the smelter to facilitate the handling of local ore; George Keibel is president.

The Hecla mine will continue to operate for the present in the hope that conditions will change so that it will be possible to mine at a profit and thus avoid a shut-down, according to a decision reached at a shareholders' meeting held recently at Spokane. Last year's board of directors was re-elected. The officers are: J. F. McCarthy, Wallace, Idaho, president; W. J. C. Wakefield, Spokane, vice-president; Mrs. Sarah E. Smith, Chicago; F. J. Kipp, Carl Landsee, Milwaukee, Wisconsin; Dr. Norman, Los Angeles, directors. The matter of reorganization of the company on

a basis of a higher capitalization was also considered. This, however, was left for action by the directors at their discretion. The Helca has a million shares of par value of 25c., which makes its capital stock \$250,000, and forces it to pay a much higher federal tax than other companies with larger capitalization. The matter of the company's Federal tax is now in process of adjustment because of this inequality.

MICHIGAN

Houghton.—A considerable amount of copper is now moving out of this district. Calumet & Hecla is in receipt of a second order for 1,000,000 lb. for Germany and the smelter and electrolytic plant will be kept in commission until this order is filled and there is a supply of cathodes in reserve. Shipment of the first 1,000,000-lb. order has been completed; the second order will go forward as soon as the desired shapes can be turned out. Both of these orders called for cakes of copper of unusual size. This metal is being consigned direct to Hamburg.

Copper Range has sent out the last shipment of its 1,600,000-lb. order for Germany. Inquiries for metal have been more numerous of late than at any time during the last few months, and there are indications that a more active market is close at hand. It is the belief of some that the market will improve sufficiently to put the metal industry back on its feet in six months; the mines that have ceased production will be closed at least that long.

Calumet & Hecla, Ahmeek, and Isle Royale, which shut-down on April 1, produced a total of 9,147,000 lb. of copper in March. This is considerably in excess of the output of any recent month, the average having been a little better than 7,000,000 lb. Calumet & Hecla produced 5,687,000 in March; Ahmeek, 2,573,000; and Isle Royale, 887,000 lb. In February these companies reported an output of 7,395,084 lb. The clean-up prior to the shut-down accounts for the increase in the March figures.

Calumet & Hecla apparently has made all preparations for a long shut-down. Pipe-lines, stope-rails, tram-cars, drill-machines, and other equipment that might be damaged by shifting or falling ground during the period of suspension have been removed. Likewise all surface equipment, including machinery, has been given careful attention to prevent deterioration. The last of the rock accumulated at the mine has been sent to the mill.

Every effort is being made to relieve the unemployment situation in Houghton and Keweenaw counties that was brought about by the shut-down of Calumet & Hecla and its subsidiaries. The Keweenaw board of supervisors and road commission has made arrangements to enlarge the highway construction program so as to give a job to every idle man in the county. This will take care of the men laid off at Ahmeek. Mohawk and Wolverine, which continue to operate, have taken on men from the suspended properties. In Houghton county a proposal will be submitted by the board of supervisors to the electors to bond the county for \$200,000 for additional road work this summer. The issue appears to be generally favored and the extra contracts planned will provide places for many men now out of employment. Calumet & Hecla will give as many men as possible temporary odd jobs around the mines; a considerable number will remain on the pay-roll. Former employees having large dependent families and who are not in a position to leave the district are filing applications at the Calumet & Hecla employment office; the ones in most urgent need will be given preference. Calumet & Hecla will keep its pumps in operation and occasional timbering will be done. In addition, the power-plant at Lake Linden will remain in commission and a number of men will be employed around the mills. The smelter will continue in operation for a month to six weeks, and the electrolytic plant for a corresponding period. Many men have left the district, the majority of them going to the

industrial centres of lower Michigan; some have found work on farms. Some cases of actual want have been reported, and it is to prevent an increase of such cases that two or three years of road work will be crowded into one.

Copper Range continues to take on more men, an average of ten per day having been employed in the last two weeks. Most of the men are experienced miners and are being given jobs in the Champion. Champion rock shipments are reflecting the steady increase in the force, the number of cars shipped daily now averaging 40, which is almost double the average maintained during the latter part of 1920. Champion alone is sending almost 2000 tons daily to the mills; the shipping of stamp-sand to the mine has been resumed from the Baltic mill, shipments having been stopped during cold weather. The sand will be used for the filling of old stopes, and will be distributed through the mine by means of compressed air. The sand used came from the mills before the Hardinge mills ground the rock so fine that it could not be used for filling work.

It has been definitely established that the formation encountered in the cross-cut east from the 81st level of the Red Jacket shaft, Calumet & Hecla, 1100 ft. from the shaft, is that of the Kearsarge lode. A small force has been kept at work exploring this ground. The formation is a series of traps and amygdaloids, and drifts have been started along favorable copper leads to prove its value. There is hope that the formation will become more regular as it is opened, the cross-cut probably having encountered it at a point where it had rolled and flattened. While the grade is not sensational, it is sufficient to warrant further development. If the Kearsarge lode is rich in this portion of the property, many years of life will be added to the mine.

Wolverine is ready to begin the removal of pillars on the 37th level in No. 4 shaft. The work in the 38th level, which has been under way for several months, is nearing completion. It is believed that the pillars will show a better grade of ore as operations extend upward, as Wolverine was richer in the upper than in the lower workings. The pillars in the 38th have been yielding about 15 lb. per ton.

Seneca is opening ground in its new 6th level drifts that is reported to be on a par with that in the 5th-level drifts. The work, however, has not yet been carried far enough to afford a forecast of what the 6th-level drifts will finally develop; but indications point to copper content as continuous as in the 5th and upper levels. The stope on the 4th level, north, the only one so far opened, is exposing ground that is considered highly favorable.

Alonzo D. Nicholas, of Calumet, has been elected secretary-treasurer of the Calumet & Hecla Mining Co. to succeed John F. Perkins, resigned. Mr. Nicholas has been acting as assistant treasurer and comptroller of the company and subsidiaries. He will make his home in Boston.

James E. Fisher has been advanced from assistant secretary to secretary of the Calumet & Arizona Mining Co., with offices at Calumet. He succeeds Gordon R. Campbell, who has been elected to the presidency of the company, to succeed Charles Briggs, resigned.

Robert H. Shields, president of Arcadian Consolidated, upon his return from Boston this week, announced that the company's present development program will be continued during the summer. The showing in the property is encouraging; officers and directors are desirous of developing it as rapidly as conditions will permit. Satisfactory progress is being made in connecting the New Arcadian and New Baltic shafts. The Victoria company has called an assessment of \$1 per share, payable on May 25.

NEVADA

Divide.—The stockholders of the Alto company are to meet on May 9 to ratify the sale of the property to the New Alto Divide Mining Co., which is capitalized for \$200,000,

divided into 2,000,000 shares of a par value of 10c each. This is in effect a re-organization and the new company will be on an assessable basis. It will have 470,000 shares in the treasury, and it is planned to dispose of this before levying an assessment. At the Alto, 2050 ft. of development work has been done, consisting of sinking of a 400-ft. shaft, and lateral work from it. Good assays have been obtained at several points. Sinking of the shaft may be resumed.

Elko.—The \$50,000 cash price for the Ingalls mine was not taken advantage of by the Silver Hills on April 15. This was a special agreement aside from the original one, which calls for the payment of \$125,000. There has been a payment of \$10,000 made under the original agreement and another payment, of \$15,000, is due December 15. However, the \$50,000 agreement can be maintained in effect by the payment of an additional \$2500 monthly. Good results are being obtained by the Silver Hills on the 100-ft. level, but the ore-shoot has not yet been entered on the 200.

A second unit, doubling the capacity, is to be added to the Catlin shale-oil plant on the arrival of machinery. The plant now treats 100 tons of shale daily. This is taken as confirmation of a recent official statement that the experiments of the company have been successful and that a method has been found for treating the shale on a commercial scale. The company has spent \$350,000 in the experimental work.

Fly.—The Consolidated Coppermines Co. has announced a \$10,000,000 bond issue. The bonds will bear interest at the rate of 8% and will mature May 1, 1936. The proceeds will be used to retire the present indebtedness and to build a reduction plant. About 20,000,000 tons of $1\frac{1}{2}$ to 7% ore is exposed in the mines.

Goldfield.—The shaft of the Goldfield Deep Mines Co. has reached a depth of 400 ft. and is advancing rapidly. When the 800-ft. level is reached a station will be cut, the hoist now on the surface moved to this point, and the Merger hoist erected at the shaft. The management is sanguine of intersecting the Goldfield Consolidated ore-channel at an approximate depth of 2400 ft.—Sinking has been resumed at the Gold Hill mine of the Goldfield Development Co. A compressor and hoisting plant have been erected, and sinking of the double-compartment shaft to water-level will be carried forward at the joint expense of the Goldfield Development and Sandstorm-Kendall companies. The shaft is to be used in development of the Gold Hill and Bonanza properties, the latter held under option and lease by the Sandstorm-Kendall company.

Hornsilver.—Engineers for the Tonopah Mining Co. are sampling the Orleans mine, in which an orebody recently was found by J. W. Dunfee, a lessee, on the 580-ft. level. Dunfee has stopped work while the engineers are conducting their examination.

Jarbridge.—It is reported that a 14-ft. vein of rich ore has been found on the 800-ft. level of the Elkora.

Silver Horn.—Buildings are being erected and within a month there will be a town of fair size. Engineers, prospectors, and miners are adding to the population rapidly, drawn by further finds made on the Silver Horn. Ore containing 12% nickel has been found; a 50-ft. vein of ore assaying more than 20 oz. silver is also reported.

Sodaville.—The Butler Divide has taken over the Aureola group of five claims five miles south-east of Sodaville, and a drift tunnel, now 200 ft. long, is being extended toward an ore-shoot exposed in workings near the surface. Mina men are taking leases on veins parallel to the main one. Several shipments were made by the former owners. One of 43,740 lb. assayed 3.05 oz. gold and 66.20 oz. silver per ton, and another, of 56,380 lb., assayed 1.94 oz. gold and 22.01 oz. silver. Sodaville is on the railroad in Mineral county.

Tonopah.—The pumps have been removed from the Helmont, Victor, and Tonopah Extension shafts. Several of the Divide companies are working, but no work is being done at the Tonopah Divide. The Klondyke district is not affected by the strike, as the old wage-scale is being paid, but shipments have been stopped because of the closing of the Helmont mill at Millers. Miners are leaving Tonopah, but only in small numbers. The miners and craftsmen have consolidated their interests in the strike by the organization of the Tonopah Workers' Association. It is thought that the State Labor Commissioner may take action after he has had an opportunity to confer with Governor Boyle, who is now in the extreme southern part of the State.

OREGON

Gold Hill.—The Roaring Gimlet mine, on Kane creek, under lease to M. A. Applegate, A. J. Armstrong, and E. W. Moore, of Medford, Oregon, has been re-opened. This mine, an old producer of rich free-milling ore, has been idle since 1906. The lessees propose to sink a deeper shaft near the old one, which is less than 100 ft. in depth and open a new level on the orebody. This property adjoins the Gold Ridge mine, where a large body of high-grade ore was recently uncovered.—The Gold Ridge Mining Co., of Medford, Oregon, is developing. The company has purchased the 10-stamp mill and equipment on the Bill Nye in the Gold Hill district. The new equipment will be operated by electric power.—It is reported that the Revenue Pocket and Alice groups, two old producers and adjoining properties on the east of the Gold Ridge, will be leased.—Work at the Millionaire group, two miles east of the Gold Ridge, has been resumed by C. A. Knight, who purchased the mine two years ago. The mine is well equipped. Ore from the upper levels is being milled.

UTAH

Bingham.—At present, the United States Mining Co. has more lessees at work in its ground than has been the case for many years. This policy is a boon to the community, for it gives employment to a number of men who have been thrown out of work by shut-downs in other mines of the district.

The Utah Consolidated Mining Co. is erecting a new 500-hp. Nordberg hoist. Although for many years the company has been one of the lowest cost producers in the State, shipments have been suspended and but 70 men are employed on the property.

Eureka.—Shipments of ore from the Tintic district totaled 121 carloads for the week ending April 16, as compared with 135 carloads for the week preceding. Tintic Standard shipped 48 carloads; Chief Consolidated, 23; Iron King, 16; Iron Blossom, 10; Gemini, 3; Swansea, 3; Eagle and Blue Bell, 2; Victoria, 2; Colorado, 2; Sunbeam, 1; Mammoth, 1.

Development work is being done on the property of the Tintic Silver Hill Mining Co., according to W. A. Dennis, manager. This property adjoins that of the Lehi Tintic Mining Co. Several north-south fissures with good showings of quartz have been opened up in doing preliminary trenching work.

Charles Zabriskie, manager in the Lehi Tintic mine, reports that the shaft being sunk in the adit at a distance of 700 ft. from the portal is nearing the 500-ft. level. When this level is reached, the shaft will have attained a vertical depth of approximately 900 feet.

The Tintic Milling Co. is preparing for shipment slightly more than 20,000 oz. of silver bullion. This shipment, to be made during the third week of April, will be the third made during the month, two other lots totaling 55,000 oz. already have gone to the Denver mint. Arrangements are being made by the company to re-open the workings of the Swansea Consolidated property for the purpose of securing for treatment the large tonnage of low-grade ore available. An electric hoist is being installed and the shaft is being re-

timbered. The Swansea up to twelve years ago was the producer of considerable high-grade ore; a large tonnage of low-grade mineral was opened up on and near the 500-ft. level. Sampling of this ore has proved that it carries silver and sulphur.

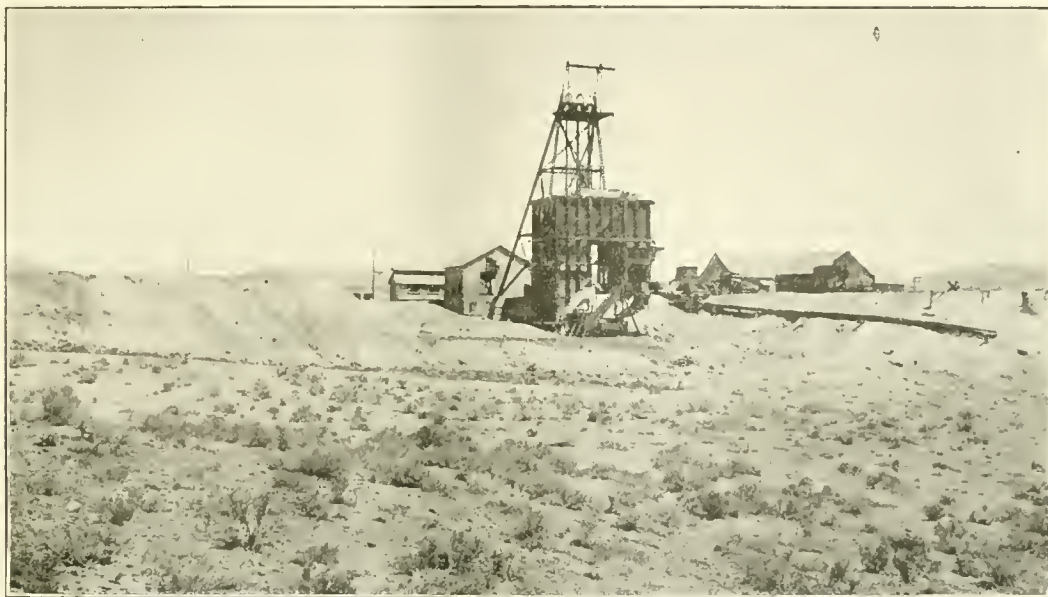
Favorable conditions are being encountered in the drift on the 1100-ft. level of the North Standard mine. At a point in a general easterly direction from the shaft an east-west cross-break has been entered. After drifting for a distance of 75 ft. in the country-rock on the foot-wall side of this fissure the break was again entered. Latest reports from the mine are to the effect that a good body of quartz was showing in the fissure.

Preparations are being made at the Little May mine in South Tintic to make regular shipments of ore. A large body of low-grade ore has been opened up on the 200-ft. level. Two carloads of ore assaying 2 oz. silver, 1.5% copper, 21.4% iron, and 22.8% sulphur are awaiting shipment.

Salt Lake City.—Reduction of 20% in the salary of officials and employees of the porphyry copper companies, paid on other than a daily basis, as announced from the New York offices, will affect a number of Utah Copper employees and officials. At present there are about 70 salaried men employed in the Salt Lake City office. On May 1, when the reduction becomes effective, this number will be reduced about 50%. After May 1, about 150 men will be employed by the company for maintenance of the mine and plants of the Utah Copper Co. and the equipment of the Bingham and Garfield railroad.

WASHINGTON

Spokane.—The Security Copper Co., of Spokane, has resumed work on its property at Chewelah and expects to work on its Chemokane and Butte mines, also in Stevens county, after a prolonged suspension.—The Ark Mines Co. has struck the vein on the Silver Queen mining claim, three miles south of Kettle Falls. The tunnel has been



The Laguna Shaft, Goldfield, Nevada

In the south drift on the 200-ft. level a full face of ore, samples of which assay from 2.7 to 5.7 oz. silver, from 3 to 6.8% copper, and \$1 in gold, has been opened up. As only one wall has been found and no cross-cutting has been done as yet, the width of this mineralization is not known. An 11-ft. body of ore of slightly better grade is awaiting exploitation in an east-west cross-break about 25 ft. from the face of the south drift.

Park City.—Park City mines shipped a total of 1087 tons of ore during the week ended April 16, as compared with a total of 1489 for the week preceding. Although production has been suspended at the Ontario mine, 154 tons from cleaning-up operations was shipped. Judge Allied companies shipped 556 tons; Silver King Coalition, 377; and Ontario, 154.

The heading of the Spiro tunnel of the Silver King Consolidated Mining Co. was advanced a total of 2487 ft.; the ditch at the side, 1632 ft. according to the annual report of the company to stockholders. Scarcity and inefficiency of labor and the large flow of water developed greatly handicapped operations. From January 1, 1916, to July 1, 1920, average wages per shift advanced from \$3.857 to \$5.757; material cost per foot, from \$7.912 to \$17.08; average labor and material cost, per foot, \$16.07 to \$40.06. In other words, labor increased for this period 182%; material, 138.5%. The average cost of driving a distance of 12,944 ft. from July 1, 1916, to July 1, 1920, was \$22,195.

driven over 1000 ft. and a considerable amount of silver and copper has been uncovered. The company controls nearly all the mining claims on this hill.—The Touchet Mining Co., at Huntsville, which reduced its output during the last season, announces that it will resume operations on May 1.—Reports from Leavenworth indicate that excitement prevailed when it became known that prospectors were in from the Old Blewett mine district and were exhibiting samples of gold taken from the bed and banks of the Peshastin creek. One nugget weighed three-quarters of an ounce; many smaller ones and coarse gold is said to have been found. The strike was made in the gulch about three miles below the big Blewett mine.

ALBERTA

Edmonton.—The original plan of the Dominion Department of Mines to send the geologists designated for work in the Fort Norman and Great Slave Lake oil districts in aeroplanes has been changed. Barges are being constructed for the purpose of taking men and supplies; the route will be along the Peace, Slave, and Mackenzie rivers. The survey work will be confined to the neighborhood of Fort Norman and Windy Point, Great Slave lake. The Imperial Oil Co.'s two all-metal aeroplanes have made one trip at Great Slave lake, each carrying 1000 lb. of gasoline, and have returned to headquarters at Peace River Crossing without mishap. It is expected that they will make the first trip to Fort Norman at an early date. The Imperial company will

have four new Californian oil-rigs in the field this year; should the aeroplane service prove successful, it will have a much longer season at the wells than before; previously, a large proportion of the time has been taken up in going to and returning from the sites. Consequently, by the end of the present season trustworthy information as to the possibilities of the new field should be available. The Imperial company's bill for a pipe-line right-of-way through the Province is meeting with a considerable amount of opposition in the local legislature on account of the indefiniteness of location, and of the excessive power requirements.

BRITISH COLUMBIA

Anyox.—The mine and smelter of the Granby Consolidated Mining & Smelting Co. continues in operation. Last December the employees agreed to accept a reduction in wages rather than have the plant closed down; H. S. Munroe, general manager, recently referred to this achievement with satisfaction; he said that wages had been reduced in accordance with a sliding-scale agreement. When the price of copper rose about 14c. the wages would automatically advance. Living costs for married men had fallen about 2% since December last.

Hazelton.—Oil seepages are reported from Burns Lake, about half way between here and Fort George, on the Grand Trunk Pacific. The discovery was made by Donald M. Gerow and his brother, who attempted to develop it by the aid of pick and shovel. Eastern capital has been interested, and the property is to be explored by a drill.—An 8-ft. body of ore, assaying \$14 per ton, has been struck by a tunnel at the Cascade group, on Hudson Bay mountain. In driving for the vein the tunnel passed through a deposit of graphite, 6 ft. in thickness.

Nelson.—The Silversmith mine is closed, pending an improvement in the price of silver, lead, and zinc. Milling operations were suspended last autumn, but since then about 40 men have been constantly employed at development work. A large body of ore has been developed, and, as the cost of labor is likely to show a further decline, it was considered good policy to suspend operations.—The Consolidated M. & S. Co. is finding an outlet for some of its large surplus of zinc in Japan, whither shipments are being made. The receipts at the smelter for the first two weeks in April totaled 16,163 tons. The whole of the ore came from the company's Kimberley and Rossland mines.

Prince Rupert.—A. J. T. Taylor, president of the Taylor Mining Co., is in England, endeavoring to interest additional capital for the further equipment of the Dolly Varden mine. It is understood that the directors of the company are desirous of erecting a concentrating plant, thus considerably reducing the quantity of material that has to be shipped. With the exception of a few high-grade shipments, the tenor of the ore runs about 35 to 40 oz. in silver.—The Granby M. S. & P. Co. has 25 men employed in developing its property at Swamp Point.

Trail.—The first quarter of 1921 shows ore receipts at the Trail smelter of the Consolidated Mining & Smelting Co. aggregating 101,898 tons. This is 35% greater than that for the opening three months of the previous year. Of the total, 99,970 tons came from the company properties; it is clear, therefore, that independent operators, affected by the low prices offered for metal, are doing no shipping, although a considerable amount of development is in progress. A shipment of 784 tons is credited to the Blue Bell mine at Riondel during the month of March.

The recent decision of the directors of the Consolidated Mining & Smelting Co. to pass a quarterly dividend, and the report of J. J. Warren, the president, have excited interest. The net profits for 1920 declined to \$291,349, against \$1,161,605 in the fifteen months covered by the previous

statement and \$949,245 in the full fiscal 1918 period. He said. "With the beginning of the new year, wages were cut about 12½%. While many of our workmen have been zealous, much greater efficiency became noticeable as unemployment elsewhere became prevalent and men began to realize the importance of production at low cost. Some materials have fallen in price, but powder, steel, and fuel, the main essentials of the company's operations, still remain at or above war prices and freight rates have been reduced but very little."

Vancouver.—The revival of gold mining in the Province, owing to the decrease in cost of labor and supplies, is shown by the receipts at the Dominion Government assay office in this city. During the first three months of the year 222 deposits, valued at \$394,244, were made, against 208 deposits, valued at \$254,234, for the corresponding period of last year. This, of course, by no means represents the Provincial production for the period, as the gold from the output of the Premier, Surf Inlet, and Granby mines is refined in the United States. Jurio Wada, a prospector who is thoroughly familiar with Alaska, Yukon, and Mackenzie River districts, has returned from a trip to the Fort Norman oilfields, having staked five 640-acre claims for a Vancouver syndicate that financed the trip.

Victoria.—With the opening of the mining season in those parts of British Columbia that are snow and ice bound for a considerable part of the year the annual exodus from the south, of prospectors, miners, and promoters is taking place. To the Peace River, the Atlin, the Cassiar, the Portland Canal, and Alice Arm, and to the Yukon districts, men interested in mining are directing their steps.

The placer gold possibilities of the Peace and its tributaries have yet to be thoroughly explored. Official reports indicate the possibility of another field; not a few sourdough prospectors are determined to continue the search. There are wide and practically unprospected areas, but it is the country drained by the Peace and Finlay rivers, and particularly the section of the Ingenika river, to which the attention of the gold-seekers is inclined.

Much activity is expected in Atlin if the litigation now hindering the operation of the Engineer mine is cleared up. Placer mining and hydraulicking on the well-known creeks of this district has been on the decline of late years, but the possibilities of successful lode mining have become better appreciated and it is probable that some promising silver, as well as gold, properties will be developed. A considerable amount of prospecting for placer gold may be expected in the Cassiar district. On Thebert creek, hydraulicking is being undertaken on a large scale with good prospects; it is considered likely that ground held under lease, and some not yet taken up, on this creek, Dease creek, McDame creek, and other waters of the locality will be inspected by engineers during the season.

In the Portland Canal district, the directors of the Premier Mining Co. have decided to proceed with the construction of an aerial tramway from their property on Salmon river to tidewater. This will be 11 miles in length, and will cost about \$250,000. This is evidence that the development of the Premier claims, by diamond drilling, stripping, and tunneling has convinced the owners that they have an ore-body that in extent and value will repay this and other heavy expenditures. It is reported that the Algonian Mining & Development Co. has ceased work on the Spider group, and that the men have filed liens on the property and equipment for the amount of their wages. W. A. Meloche, the head of this concern, is engaged in the organization of the Northern Light Exploration Syndicate to take over the Northern Light, Spider, Cobalt, and Lake and O'Leary properties. If this re-organization is successful, the development of the Spider and other claims will be continued. The success of the

Premier mine, however, will serve to sustain confidence in the district, and there will be a large influx of prospectors and miners this year.

Among the estimates in the Provincial budget for the coming year are: \$10,000 to assist prospectors in the purchase of blasting powder; \$40,300 for mine inspection; \$15,645 for mine-rescue work; and \$60,000 for oil exploration in the Peace River district.

ONTARIO

Beaverhouse Lake.—The annual statement of the Argonaut for 1920 shows a production of \$82,513, from the treatment of 4637 tons of ore. The ore mined during the year contained an average of \$10.01 gold per ton of which \$7.01 was recovered by the use of the straight amalgamation stamp-mill which was used solely for test purposes. One ore-shoot has a length of 200 ft. and is 6 ft. in width, containing an average of \$15.75 per ton. A new modern mill is proposed to be erected just as soon as developments justify the work, when the percentage of recovery will be much greater than with the present testing mill.

Cobalt.—The directors of the Nipissing Mining Co. have reduced the regular quarterly dividend to 3% amounting to \$180,000 as compared with the former rate of 5% amounting to \$300,000. It is officially stated that the 3% dividend declared for the current quarter represents about the full amount earned for the first quarter of the year, hence the reduction. In recent years, the Nipissing has paid 5% quarterly, plus two bonuses of 5% each year. The question of whether or not the new rate of 12% is to continue for any great length of time will probably be determined by the market price of silver. The Aladdin-Cobalt is shipping 25 tons of low-grade ore daily, in addition to bagging a small amount of high-grade ore from a two-inch vein.—At the Coniagas mines, 8-oz. ore is being handled on a profitable basis, at what is believed to be the lowest operating costs achieved in Cobalt.—Due to the declining activity in the Cobalt district, the interests identified with the hydro-electric power plants are considering a scheme to erect a pulp mill near Haileybury, on the shore of Lake Temiskaming, as a means of utilizing the surplus power supply.—During the course of mining for cobalt metal on the Haileybury Frontier property in South Lorrain, a shoot of high-grade silver ore has been encountered and a small amount is being assembled for shipment. The Wettlaufer mine in that area produced over 2,000,000 oz. of silver a few years ago.—Only 100 men are employed in the Gowganda field. Poor transportation and low price of silver as well as a power shortage combine to restrict activity. This week, the spring break-up has relieved the power situation, and a number of small mining prospects will be re-opened. The property owners declare that the failure to make progress is due more to lack of railway transportation than to lack of merit in the properties themselves. Costs are augmented by the 27-mile wagon or sleigh haul.

Gowganda.—There is some revival of activity in this district, which has been badly handicapped by transportation difficulties and power shortage. The number of men employed in the field has decreased to about 100 as compared with 300 a year ago. The Miller Lake-O'Brien, which had been compelled to curtail its output due to power shortage, has now an adequate supply, and is working at full capacity with three shifts.—The Castle is operating steadily with good results. Several properties have been re-opened including the McAlpine, Powerful, Gowganda Enterprise, and Thompson Gowganda. The Saunderson property at Wigwam Lake is bringing in a steam-driven plant, preparatory to active development.

Kirkland Lake.—An official statement following the visit of H. G. Latilla and Conrad E. Jorgenson of the Kirkland

Lake Proprietary (1919), Ltd., has been issued. The company either owns or controls four adjoining gold mining properties in the Kirkland Lake field, aggregating 600 acres in extent on which 15 separate goldbearing reefs have been found. Three of these properties are known as the Tough-Oakes, Burnside, and Sylvanite, the fourth is as yet unnamed, but immediately adjoins the Tough-Oakes on the north-eastern boundary. The company's silver-mining property in the Cobalt field is known as the Aladdin-Cobalt. One reason for the visit of Messrs. Latilla and Jorgenson was to meet would-be buyers of some of the company's mining interests; but after their investigation of the mines they unhesitatingly declined to consider the proposal, feeling certain that the retention of such interests will prove to be to the advantage of shareholders. The necessary funds for again bringing the Tough-Oakes and other properties to a dividend-paying stage being available, arrangements have been made for the immediate resumption of work, which will be facilitated by the certainty that a considerable amount of cash will accrue from the silver deposits being developed in the Aladdin-Cobalt mine.

Porcupine.—The camp is attracting much attention from American investors, many mining men and engineers having recently arrived from New York, Pittsburgh, and California. Several big deals have been closed, or are under way. The Goldal Mining Co. has taken over the entire holdings of the Bewick-Moreing interests consisting of upward of 50 claims with a total area of 2000 acres. Thirty claims belonging to the Northwoods Mining Co. are involved in a deal with English interests. Everything indicates a great revival of mining activity.

The question of the re-opening of the Porcupine Vipond-North Thompson mine was considered at the annual meeting on April 12 and it was decided not to make the necessary arrangements until financial conditions became easier and mining conditions showed improvement. The financing necessary for the current year will be provided by the Associated Gold Mines of Australia, which is largely interested in the company. J. Mackintosh Bell, the company's engineer, stated that he had every confidence that the property would become a producing mine, but it would require \$200,000 to put the mill in proper shape, and open up underground workings on the 900-ft. level.

The Crown Trust Co., of Montreal, has taken up \$100,000 in mortgage bonds of the North Crown mines. It is planned to resume milling operations about May 1.

Sudbury.—The court at Toronto has dismissed the application of M. J. O'Brien for an injunction restraining the British America Nickel Corporation from carrying into effect the proposed scheme for financial re-organization. The judgment stated, however, that the corporation would carry out its plans at its own risk, and that if O'Brien, as a minority shareholder, suffered any injury as a result of the corporation's action he would be able to seek redress in the courts.

MEXICO

Durango.—E. A. Miller is preparing to develop the San Juan mines in the Pueblo Nuevo district, where the ores contain gold, silver, and copper. Some of the old mills of this region, which have remained idle since being partly destroyed during the revolution, are to be repaired and operated.—Both the Inde and Guanacevi camps are active as far as development work and new filings are concerned, but the smelters and principal mines are idle pending an improvement in general conditions. The Guadalupe group of mines in the Inde district was recently declared forfeited for non-payment of taxes and has been taken up under the same name by native miners of the camp.—J. P. Flynn, at one time manager for the Avino Mines Co., Ltd., is expected to arrive shortly from Mexico City to look after development

work on some promising properties in the Avino district. Most of the mines of this region contain large bodies of low-grade ore, but there are some small veins of high grade.

La Buena Suerte group of four mining pertenencias has been taken up by native miners of the Santa Maria del Oro district. The vein exposes some good surface ores containing gold and silver. The properties are in the vicinity of the Salvadora, Anita, and El Cometa mines.

Isidro G. Pena has applied for patent to the Acacia group in the Guanacevi district, where there is at present considerable activity in filing on new claims. William Donatlan has filed on eight claims to be known as the Palmena Numero 2 group and A. T. Benitez has located the El Tanque group adjoining the Santa Cruz, La Revancha, and La Concordia mines.

The La Esplendida mines, in the Candela mountains of the Santa Maria del Oro mining district, have been acquired by Tobais Guzman and will be developed. These properties were formerly owned by William Benton, who was killed in Juarez several years ago by Villistas. After his death the mines were abandoned and forfeited by the Secretary of Hacienda. They are re-located under the name of Morelos.

Monterrey.—All the smelters of the A. S. & R. Co. in Mexico are now closed down, the latest being the plant at Aguas Calientes. At each of these smelters a small force of men is retained for protection and to make repairs. Development operations at the mines of the company are also practically suspended, although in a few instances some work is being carried on. No information is available as to when operations will be resumed, but it is indicated that it may be several months.

Los Placeres Mining Co., of Saltillo, has appropriated a considerable sum of money to be used in development work upon its properties. It is planned to increase largely the ore output of the mines.

Leon Sanchez has taken over a group of five claims in the Guanacevi district and will develop them as soon as the necessary machinery and equipment can be erected. The group of claims is situated close to rich producing mines. His brother, Jesus Sanchez, has filed upon a claim in the same district and will develop the property.

After a partial suspension of operations for more than five years the Batopilas Mining Co. is preparing to resume development work upon its mines in the western part of the State of Chihuahua. The working force is now about 500; this will be increased to more than 2000 as rapidly as the plans can be carried out.

Torreon.—A number of mining titles are being cancelled by the Secretary of Hacienda, and in a great many instances the properties are re-located under another name by new applicants. Regardless of the almost complete paralyzation of the mining industry there is activity among prospectors and at the mining agencies. In most of the camps throughout the State of Durango development and construction work is being maintained with a small force of men. When smelting operations are again resumed a large amount of ore will be available owing to the fact that large quantities are now being blocked out ready to be mined.—An effort on the part of the management of the Torreon smelter to resume operations in order to dispose of the ore on hand and to satisfy a number of shippers who are clamoring for liquidations has so far failed, owing to the inability of the railroads to bring in a sufficient fuel supply. There are also many cars of ore in transit which the owners are anxious to deliver to the smelter but which are tied up by the railroad strike.—Thousands of miners are passing through Torreon daily en route from the camps of Arizona to their homes in the interior. These people have free transportation over the Mexican railroads to any point they desire to go; but, owing to the paralyzation of the mining industry in this country, many of them will be unable to find employment.

PERSONAL

The Editor invites members of the profession to send particulars of their work and appointments. The information is interesting to our readers.

S. Paul Lindau is at Pachuca, Mexico.

Fred Searls is expected to return to San Francisco from China in July.

G. W. Schelling, of Hollywood, California, has gone to Seward, Alaska.

Henry L. Hollis, of Chicago, passed through San Francisco on his way to Mexico.

E. T. McCarthy arrived at Vancouver on April 18 on his return from China to London.

Charles W. Goodale passed through San Francisco after a holiday in southern California.

A. W. Newberry is at Cleveland for a couple of weeks, returning to New York on May 9.

John A. Burgess has returned from Kingman, Arizona, where he examined the Dean mine.

Richard A. Parker, of Denver, has been taking a holiday at Del Mar, in southern California.

A. B. Parsons, of the 'Mining and Scientific Press', visited the Engels copper mine this week.

William D. Thornton, vice-president of the Inspiration Consolidated Copper Co., was here last week.

D. W. Brunton has returned to Denver from a pleasure cruise among the islands of the Caribbean Sea.

Harry H. Webb passed through San Francisco on his return from his ranch, in Siskiyou county, to Los Angeles.

Livingston Wernecke has returned to Nixon's Fork, Alaska, where he is in charge of prospecting operations for the Alaska Treadwell Mining Company.

Sherwood Aldrich, president of the Ray Consolidated Copper Co., arrived in New York recently on the 'Aquitania' after a four months trip around the world.

W. S. Noyes, who has been the victim of litigation for six years in consequence of a suit brought against him as president and general manager of the Presidio Mining Co., a silver enterprise in Texas, has been acquitted of the charge brought against him by Capt. W. S. Overton. The case went to the U. S. Supreme Court, which, on April 25, refused to review the decision of the lower courts. Mr. Noyes has many friends in the mining profession and all of them will be delighted that at last he has been relieved of this harassing litigation.

Obituary

Edwin A. Jacobs died on April 9 in the Longfellow hospital, at Morenci, Arizona. He was born in 1854, in Australia, and went to Greenwood, British Columbia, in 1898, where he served as accountant to the British Columbia Copper Co. Here he began his career as a press correspondent. In 1902 he became associated with H. Mortimer-Lamb in publishing the 'B. C. Mining Record', at Victoria, and in 1905 he became the sole proprietor, conducting this paper until 1908. During this period he acted as secretary of the Western branch of the Canadian Mining Institute and continued to serve as correspondent for several papers, including the 'Mining and Scientific Press'. Owing to failing health, he left British Columbia three years ago and became connected with the Arizona Copper Co. as store-keeper at Morenci. Edwin Jacobs was of a rare type, a scrupulous reporter; he was sincere and honorable in all his work, in the performance of which he undoubtedly served British Columbia to excellent purpose. We valued him as our correspondent in the North-West, we esteemed him as a man, and we mourn his passing.—T. A. R.

THE METAL MARKET



METAL PRICES

San Francisco, April 26

Aluminium-dust, cents per pound.....	75
Antimony, cents per pound.....	7.50
Copper, electrolytic, cents per pound.....	13.00
Lead, pig, cents per pound.....	4.60—5.60
Platinum, pure, per ounce.....	\$75
Platinum, 10% iridium, per ounce.....	\$105
Quicksilver, per flask of 75 lb.....	\$50
Spelter, cents per pound.....	7.50
Zinc-dust, cents per pound.....	12.50—15.00

EASTERN METAL MARKET

(By wire from New York)

April 25.—Copper is fairly active and firm. Lead is quiet and steady. Zinc is active and higher.

SILVER

Below are given official or ticker quotations for silver in the open market as distinguished from the fixed price obtainable for metal produced, smelted, and refined exclusively within the United States. Under the terms of the Pittman Act such silver will be purchased by the United States Mint at \$1 per ounce, subject to certain small charges which vary slightly but amount to approximately three-eighths of one cent. The equivalent of dollar silver (1000 fine) in British currency is 46.65 pence per ounce (925 fine), calculated at the normal rate of exchange.

Date	New York	London	Average week ending			
	cents	pence		Cents	Pence	
Apr. 19.....	60.12	34.87	Mch. 14.....	55.12	32.04	
" 20.....	60.62	35.00	" 21.....	56.69	33.00	
" 21.....	59.75	34.50	" 28.....	57.69	33.45	
" 22.....	59.87	34.62	Apr. 4.....	56.92	32.98	
" 23.....	60.62	35.00	" 11.....	58.00	33.54	
" 24 Sunday			" 18.....	60.18	34.83	
" 25.....	60.37	34.62	" 25.....	60.22	34.77	
Monthly averages						
	1919	1920		1919	1920	1921
Jan.	101.12	132.77	July	106.36	92.04	....
Feb.	101.12	131.27	Aug.	111.35	96.23	....
Mch.	101.12	125.70	Sept.	113.92	93.66	....
Apr.	101.12	119.56	Oct.	119.10	83.48	....
May	107.23	102.69	Nov.	127.57	77.73	....
June	110.50	90.84	Dec.	131.92	64.78	....

COPPER

Prices of electrolytic, in cents per pound.

Date			Average week ending	
Apr. 19.....	12.50	Mch. 14.....	12.16	
" 20.....	12.50	" 21.....	11.87	
" 21.....	12.50	" 28.....	12.15	
" 22.....	12.50	Apr. 4.....	12.68	
" 23.....	12.50	" 11.....	12.50	
" 24 Sunday		" 18.....	12.50	
" 25.....	12.50	" 25.....	12.50	
Monthly averages				
	1919	1920	1921	
Jan.	20.43	19.25	12.94	
Feb.	17.34	19.05	12.84	
Mch.	15.05	18.49	12.20	
Apr.	15.23	18.23	.....
May	15.91	18.05	.....
June	17.53	19.00	.....
July	20.82	19.00	.....
Aug.	22.51	19.00	.....
Sept.	22.10	18.75	.....
Oct.	21.66	16.53	.....
Nov.	20.45	14.03	.....
Dec.	18.55	13.18	.....

LEAD

Lead is quoted in cents per pound, New York delivery.

Date						Average week ending					
Apr.	19.			4.25		Mch.	21.			4.04	
"	20.			4.25		"	14.			4.00	
"	21.			4.25		"	28.			4.00	
"	22.			4.25		Apr.	4.			4.39	
"	23.			4.25		"	11.			4.25	
"	24 Sunday					"	18.			4.30	
"	25.			4.25		"	25.			4.25	
Monthly averages											
	1919	1920	1921				1919	1920	1921		
Jan.	5.60	8.05	4.96			July	5.53	8.63			
Feb.	5.13	8.88	4.54			Aug.	5.78	9.03			
Mch.	5.24	9.22	4.06			Sept.	6.02	8.08			
Apr.	5.05	8.78				Oct.	6.40	7.28			
May	5.04	8.55				Nov.	6.76	6.37			
June	5.32	8.43				Dec.	7.12	4.76			

TIN

Prices in New York, in cents per pound.

Monthly averages							
	1919	1920	1921		1919	1920	1921
Jan.	71.50	62.74	35.94	July	70.11	49.29	....
Feb.	72.44	59.87	32.16	Aug.	62.20	47.60	....
Mch.	72.50	61.92	28.87	Sept.	55.79	45.43	....
Apr.	72.50	62.17	.....	Oct.	54.82	40.47	....
May	72.50	54.99	.....	Nov.	54.17	36.97	....
June	71.83	48.33	.....	Dec.	54.94	34.12	....

ZINC

Zinc is quoted as spelter, standard Western brands, New York delivery, in cents per pound.

Date	Average week ending		Average week ending				
Apr. 19.....	5.15	Mch. 14.....	5.25				
" 20.....	5.20	" 21.....	5.25				
" 21.....	5.30	" 28.....	5.20				
" 22.....	5.35	Apr. 4.....	5.15				
" 23.....	5.35	" 11.....	5.15				
" 24 Sunday		" 18.....	5.14				
" 25.....	5.40	" 25.....	5.29				
Monthly averages							
	1919	1920	1921				
Jan.	7.44	9.56	5.86	July	7.78	8.18
Feb.	6.71	9.15	5.34	Aug.	7.81	8.31
Mch.	6.53	8.93	5.19	Sept.	7.57	7.84
Apr.	6.49	8.76	Oct.	7.82	7.50
May	6.43	8.07	Nov.	8.12	6.78
June	6.91	7.92	Dec.	8.69	6.03

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, according to quantity. Prices, in dollars per flask of 75 pounds.

Date		Average week ending		per hour of the		pods.		
Mch.	29	.....	46.00	Apr.	12	.....	45.00	
Apr.	5	.....	45.00	"	19	.....	45.00	
				"	26	.....	50.00	
Monthly averages								
		1919	1920			1919	1920	1921
Jan.	.....	103.75	89.00	.....	July	.....	100.00	88.00
Feb.	.....	90.00	81.00	.....	Aug.	.....	103.00	85.00
Mch.	.....	72.80	87.00	.....	Sept.	.....	102.60	75.00
Apr.	.....	73.12	100.00	.....	Oct.	.....	86.00	71.00
May	.....	84.80	87.00	.....	Nov.	.....	78.00	56.00
June	.....	84.40	85.00	.....	Dec.	.....	95.00	52.50

JUDGE GARY ON LABOR UNIONS

Chairman Gary of the Steel Corporation, addressing stockholders at the annual meeting, said:

"The workman, if he belongs to a labor union, becomes the industrial slave of the union. He has no power of initiative or opportunity to apply his natural mental and physical capacity. If our own shops should become thoroughly unionized and all others likewise should recognize the unions, and the steel industry should become entirely organized, as the leaders have openly attempted, then the management would be in the hands of the unions. Some of you have, no doubt, personally seen or read of the results of complete organization by the unions in certain lines.

"The natural and certain effects of labor unionism are expressed in three words: Inefficiency, high costs. And be it remembered that in the end the general public, which is more interested in selling prices of all products, must pay for extortionate, unnecessary, and unreasonable cost of production. It is primarily, fundamentally, and finally interested in the existence and conduct of labor unions.

"The end sought by labor union leaders, that at least to which their efforts tend, means disaster and destruction.

"I would not intentionally do an injustice to any union labor leader, nor to a labor union. But I firmly believe complete unionization of the industry of this country, as attempted, would be the beginning of industrial decay.

"Possibly there is a solution of or antidote to the labor union problem. 'I do not believe in socialism; in governmental management or operation; but I do advocate publicity, regulation, and reasonable control through government agencies. Members of commissions or departments should be non-partisan, non-sectarian, based on qualification and moral character. Their decisions should be subject to review by the highest courts.

"Laws—clear, well defined, practicable and easy of comprehension—covering these matters might be passed, and if so they should apply to all economic organizations, groups, or bodies exceeding certain specified numbers or amounts. Both organized capital and organized labor should be placed under these laws. Each should be entitled to the same protection and be subject to the same restrictions and provisions. Will labor unions consent to this? They have heretofore objected. Here would be a test. Labor union leaders have before now asked and received discriminatory exemptions. This is wrong, and it would be just as bad if the situation were reversed. Employers generally desire only the same treatment that is accorded to labor unions. The large majority of workmen also would be satisfied with this standard.

MONEY AND EXCHANGE

Foreign quotations on April 26 are as follows:

Sterling, dollars:	Cable	3.95 3/4
	Demand	3.96 1/2
Francs (cents):	Cable	7.57
	Demand	7.59
Lire, cents:	Demand	4.92
Marks, cents		1.50

Eastern Metal Market

New York, April 20.

A better tone prevails in several markets, but prices are not quotably higher.

There has been a better foreign demand for copper, principally from Japan, and prices, though no higher, are firm.

Tin is steady and firm on better industrial conditions in England.

Lead is in fair demand, with prices moderately steady.

A better demand for zinc has appeared, which has removed the easy tendency of prices and caused them to be firmer.

IRON AND STEEL

The chief effect of the coming together of independent and Steel Corporation prices, by the raising of the former and the lowering of the latter, was the closing of business by the independent companies on which they had made quotations below the new level, says 'The Iron Age'. Thus the bulk of the new orders of the past week has gone to the independents, but at the same time the Steel Corporation has been helped by the reinstatement of business which had gone off its books while it was maintaining Industrial Board prices. There is no indication that consumers will change their policy of limited buying. The Steel Corporation's policy in respect to wages is admittedly a factor in the determination of future prices. As to building operations, the cut in steel is of small moment in comparison with the high labor-scales in all building trades.

Protests are going to Washington from independent steel producers against a high duty on ferro-manganese, report having it that \$22.40 per gross ton had been favorably considered. Some of the protests urge that ferro-manganese remain on the free list and that anti-dumping provision be relied on to prevent unfair competition.

COPPER

The feature of the week has been the activity of Japan in this market. Sales of 1250 to 1500 net tons of electrolytic copper have been made and in addition there are inquiries totaling 1500 tons more from the same source. Late in the War and after the Armistice Japan was a heavy buyer of American copper, but after the economic collapse in that country last year the purchases were small. Domestic buying continues light and of the hand-to-mouth order. Prices continue steady to firm, with electrolytic quoted at 12.75 to 13c., delivered, depending on the position up to and through the second quarter. The New York quotation is $\frac{1}{2}$ c. under these. Export prices are slightly higher. Lake copper is quiet and unchanged at 13 to 13.75c., delivered, depending on the position.

TIN

The change in the British coal-strike situation has been the leading factor in this market; the evident collapse late last week changed the complexion of the market both here and there. Before that, conditions had been dull and uninteresting. Late Friday, on better news from England, the market here became more active and stronger. Dealers turned to buyers, with sales resulting at 29.75 to 30.25c. for Eastern shipment. It is stated that sellers, however, were not many and that more could otherwise have been sold. The effect of this advance here was better prices in London on Monday, the advance over Friday having been at least £5 per ton. This also influenced the market here Monday, which went to 31c. for spot Straits, New York, the same price prevailing yesterday. The higher prices, however, killed business here, so that the market has not been active nor responded to the London sentiment. British prices, however, are £7 to £8 per ton higher than a week

ago yesterday, quotations having been £168 per ton for spot standard, £169 15s. for future standard, and £176 for spot Straits. Arrivals thus far this month have been only 460 tons, with 1100 tons reported afloat.

LEAD

It appears that Spanish lead is likely to be a factor in this market, or is so already. The appearance of 2000 tons was reported a week ago as arriving here, but now it is reported that an American consumer has purchased several thousand tons. The extent of foreign lead as a market factor is hard to define just now. At the present rate of exchange (\$3.93 for £1), imported lead, duty paid, would involve a cost of 5c. per pound, seaboard. The American product is selling at 4.25c., New York and St. Louis, by the leading interest; independents are quoting and selling higher, at 4.25c., St. Louis, and 4.37 $\frac{1}{2}$ to 4.45c., New York. It is evident that certain interests figure that any large quantity of American lead cannot be bought at any advantage over the foreign, or at least at not enough advantage to pay. We quote the market at 4.25c., both New York and St. Louis, with the American Smelting & Refining Co. evidently taking care of most of the demand.

ZINC

Galvanizers are reported as more active and as making more purchases than in some weeks. The quantity is not large, only relatively so as compared with recent buying, but the movement has contributed a slightly better tone, and has caused prices to be a little firmer. Prime Western has sold in small quantities as low as 4.62 $\frac{1}{2}$ c., St. Louis, during the past week, but it is now difficult to buy at less than 4.65c. for early delivery, with 4.70c., St. Louis, not unlikely soon. May delivery has sold in one case at 4.70c., St. Louis. We quote the market at 4.65c., St. Louis, or 5.15c., New York, for early delivery. Any foreign parcels are held at 5 to 5.10c., seaboard.

ANTIMONY

The market is unchanged with quotations nominal at 5.12 $\frac{1}{2}$ c., New York, duty paid, for wholesale lots for early delivery.

ALUMINUM

A few sales of foreign virgin metal are reported in 25 to 100-ton lots at 23 to 23.50c., New York, which is the prevailing quotation from this source, but the leading American producer is quoting 28c. f.o.b. plant, for the same brand.

ORES

Tungsten: The market is unchanged. Inquiry is light and buying is lighter. Quotations are nominal at \$3 to \$3.25 per unit in regular concentrates. Ferro-tungsten is unchanged at 58c. per pound of contained tungsten in guaranteed lump form.

Molybdenum: Quotations are nominally unchanged at 55 to 60c. per pound of MoS₂ in regular concentrates.

Manganese: No buying is reported, although low offers have been made on about 2000 tons of foreign ore. Quotations are 25 to 30c. per unit, seaboard, nominal, which contrasts with as high as \$1 last year and with 65c. per unit on some cargoes reaching American consumers under contract.

Manganese-Iron Alloys: Buying of both ferro-manganese and spiegeleisen is confined to small lots at the regular quotations of \$90, delivered, and \$32 and \$36, furnace, respectively. The tariff on ferro-manganese is an uppermost quotation, but it is believed that only a small duty will be imposed, if any.



T. A. RICKARD, . . . Editor

FROM Moscow comes the announcement that the Soviet government is coining silver because the peasants have lost confidence in paper money. In the long run the mints turn out better money than the printing-presses, and the moujiks appear to have discovered it at last. The silver miner will congratulate them, and himself, on this belated discovery.

THE recent meeting of the San Francisco section of the Institute proved unusually interesting, because, among other reasons, the attendance included an ex-president, Mr. Sidney Jennings, and one who ought to be an ex-president, Mr. Charles W. Goodale. Both addressed the meeting and referred to the bonds of goodwill that link the various sections of our professional organization.

GRADUATES from schools and colleges are receiving much advice of one kind or another at about this time, but none will receive sounder admonitions than those given by Mr. H. Foster Bain, the Director of the U. S. Bureau of Mines, to the students at the Michigan College of Mines. We reproduce Mr. Bain's address in this issue. The fathers of student sons will find it well worth the reading, for it is rich in two most excellent ingredients, common sense and humor.

THE statement made by Mr. W. Jett Lauek, economist for the unions, before the U. S. Labor Board recently, to the effect that New York banks had combined to effect a deflation of labor costs and were in favor of encouraging unemployment, has met with an unqualified denial from Mr. Charles H. Sabin, of the Guaranty Trust Company. The industrial depression is due to post-war and world-wide conditions; and not, as alleged, as a result of a strike made by capital against society. Capital would lose more than labor if it attempted to make the latter 'come to its knees'.

SPEAKING of reporters, as we did last week, it is interesting to note an article in the 'Review of Reviews' by Mr. Cornelius Vanderbilt Jr., the latest accession to the ranks of ephemeral journalism. On account of his plutocratic antecedents, he received a large measure of snobbish recognition when in California at the end of last year. In his article Mr. Vanderbilt refers to the Britannia copper mine, of which our readers know some-

thing, at least a little more than Mr. Vanderbilt, for he writes: "the famous Britannia Mine, which is recorded as the largest copper output vein in the world, being almost twice as large as the Kinnecot vein in Nevada". It is a cheap trick to describe a thing as "famous" when you know very little about it, and it is a common weakness of the ordinary reporter, such as Mr. V., to compare one thing of which he knows little with another thing concerning which he knows less. Apropos of which we recall a recent article in the 'New York Times' on the use of lethal gas for disposing of criminals in Nevada. In that article we are told that "Carson City, the capital, where the prison is situated, is 32 miles from the main line of the railroad, and escapes must be made on foot through the desert, where there is many a rattlesnake, and many a mile between drinks". This scribbler overlooks the fact that escaping criminals are not averse from traveling on a branch line of railroad and that there are at least as many automobiles in Carson City and its vicinity as there are rattlesnakes. As for drinks, has he not heard of the discovery of hoochite?

BOOSTING for San Francisco, at the expense of the southern part of the State, is the order of the day in our miserable local press. "We'll tell the world!" is the slogan. How well they tell it is suggested by the headlines in the two evening papers for two successive days. One paper screamed "S. F. Father Kills Two Sons"; the other bellowed "Hunt Slain Boys". The next evening one paper told the world we were "Hunting Girl's Slayer in Golden Gate Park", while the other announced stridently that we were about to "Jail Fake S. F. Pastor". Our new paper, and the only decent one, 'The Journal', makes fun of the booster campaign, as well it may. The 'Bulletin' announces that its newsboys are being taught to sing "the new Northern California boost song" and publishes a photograph of the boys in the act of being taught by an Orpheum singer. Other people wear buttons bearing a mystic 'BB'. We are reminded of the man who tried to sell supplies to a farmer and pestered him with his solicitations, until he retorted by saying "I've sold all my cows". The dealer continued his importunities, and again the farmer said "I've sold all my cows". Still he persisted. A third time the farmer said "I've sold all my cows". Irritated, at last, the dealer demanded the explanation of his re-

peated statement about the selling of the cows. The farmer replied: "I don't need your bull".

SPEAKING of the cause of the industrial depression of today, Mr. Francis H. Sisson said recently that "the enactment of emergency tariff legislation, the changing of taxes, the return to inflation, the reduction of railroad rates, and other similar measures advocated today as panaceas of our domestic ills, cannot solve our problem. They could not materially better domestic conditions even were all of them sound and safe—which they are not—because the real reason for our present depression lies in international economic paralysis. Our task, therefore, is to help world stabilization; the sooner we appreciate that duty, as well as opportunity, the quicker will we dissipate the depression that retards business activities in this country". In other words, we must discard the policy of insularity and provincialism; our problems are international, not domestic.

ONE might infer, judging by the noise they make, that the Irish were the most numerous foreign element in California, but such is far from being the fact. According to the Director of the Census, the 681,654 white foreign-born, in California's population of 3,500,000, are distributed as follows: Italians 88,803, Mexicans 86,638, Germans 67,199, Canadians 59,566, English 58,569, Irish 45,311, Scots 16,597, Welsh 3433, Australians 3984, Russians 27,223, Portuguese 24,517, French 20,385, Austrians 13,252, Swiss 16,097, Swedes 31,923, Danes 18,719, Norwegians 11,460. The figures are interesting. The Irish constitute only 6.6% of the foreign-born, but they are so vociferous in politics and so prominent in police and police-court affairs that one might suppose they represented 66% of the foreign-born, or, indeed, of the entire population of California.

MINERS' phthisis is a complaint that deserves specialized consideration on the part of the owners of mines in which conditions are favorable to the development of tuberculosis. A report recently issued by the U. S. Public Health Service, and written by Dr. W. H. Drury, deals with health conditions in a large factory in a Connecticut town, in which a considerable amount of grinding and polishing is carried out; it is shown that the death-rate from tuberculosis, between 1900 and 1920, among employees who worked for six hours per day in a humid atmosphere that was laden with acutely angular silicious particles was 19 per 1000, as compared with 1.5 per 1000 in the whole of the State. The most important conclusion reached was that the death-rate among the wet-grinders is much higher than among the dry-grinders. The point is of considerable interest to those concerned with operations in metal mines in which a silicious dust is produced during drilling, and where humidity is largely increased as a result of spraying. We venture to suggest that the conclusion as regards the relative death-rate among workers in a humid as compared with a dry atmosphere is liable to mislead. It is common knowledge that in the majority of cases a post-

mortem examination of an apparently healthy individual will reveal the fact that he is suffering or has suffered at one stage of his life from pulmonary tuberculosis. It is obvious that the disease is contracted in the first place more easily if the lung surface is scarified by friction with dry silicious particles. Once the damage has been done, once the tubercle bacillus has found lodgment, the development of the disease is hastened by environment in a humid atmosphere. In most cases it is considered that the good done by the allaying of dust in a mine is sufficient to more than counterbalance the ill effects of increased humidity. A discussion on the subject would probably elicit some valuable information.

Institute Affairs

On April 26 the members of the San Francisco Section received the report of a committee appointed at the March meeting to advise upon "relations with the central organization" in New York. The committee consisted of Messrs. Albert Burch, Abbot A. Hanks, and Wilbur H. Grant. We give the text of their report on page 645 of this issue. Space prevents us from discussing more than two of the six recommendations, all of which were accepted, save one, namely, the third, which approved the continued publication of the Institute's magazine, entitled 'Mining and Metallurgy'. The meeting rejected this clause by a vote of 18 to 5, several members not voting. Messrs. J. W. Neill, J. M. Hyde, C. C. Brayton, and F. W. Bradley spoke in favor of discontinuing the publication of the magazine. Having regard to the personnel of the committee, it was surprising how little argument was forthcoming in opposition to this decision. It was the sense of the meeting that a bulletin giving sundry items of information would suffice, among the items specified being the index of engineering literature, the notices of meetings, and the names and records of candidates to membership. The last clause of the committee's report expressed regret that the officers of the Institute, after inviting the Section to name the personnel of a committee to investigate the Institute's affairs, should have seen fit to appoint another committee for the same purpose. It will be recalled that on January 11 the Section disapproved of the manner in which the \$10 "voluntary contribution" was levied and suggested the appointment of a committee to investigate the finances of the Institute, in view of an acknowledged deficit. On January 28 the directors responded by inviting the Section to nominate the personnel of the proposed committee. On February 8 the Section nominated Messrs. C. R. Corning, Arthur S. Dwight, W. R. Ingalls, E. W. Parker, and Robert M. Raymond. On March 2 the president, Mr. Edwin Ludlow, wrote to Mr. Burch, a vice-president, informing him that he (Mr. Ludlow) had nominated a committee consisting of three new directors, Messrs. E. L. De Golyer, George Otis Smith, and Walter H. Aldridge, together with Mr. D. M. Liddell. As the dates show, this committee was appointed after the San Francisco section had complied with the directors' request that the Section nominate a committee for the same purpose. It is true,

as was explained by Mr. Ludlow, that two of the first committee, namely, Messrs. Raymond and Dwight, had been directors last year and therefore, it was said, were unwilling to serve as investigators, but it is obvious that the Section had particular confidence in them and disregarded the fact of their having been directors. Moreover, even this explanation, which is not convincing, did not excuse the rejection of the other nominees, Messrs. Parker, Ingalls, and Corning, all of whom are particularly fitted to discharge the task allotted to them by the Section. The resolution of the board of directors on January 28, requesting the Section to suggest the personnel of the committee, dwelt needlessly on "the deep concern in the welfare of the Institute which has been characteristic of the San Francisco Section" and was taken by many of our local members as ironical, this interpretation being confirmed by a later letter from the Secretary to the chairman of the Section, Mr. Frank L. Sizer, in which the Secretary said: "The San Francisco section has been of real service to the Institute and has shown its loyalty. It has served as the crystallizing point for dissatisfaction within the Institute." The letter containing this unfortunate phrase was read at the last meeting of the Section and provoked expressions of resentment. The Section, we venture to say, expects neither to be patted on the head as if it were a small boy nor to be struck in the face as if it were a renegade. We on this side of the continent, just as much as our friends on the other side, are desirous of promoting the best interests of the Institute and of the profession it represents.

The Cost of the War

An estimate of the total cost of the War appears in the Congressional Record of March 5. The main purpose of the investigation was to show the unreasonableness of a request that the United States should cancel any of the war debts that the Allies in Europe contracted with us; the issue is, therefore, entirely a moral one. This being the case, it is absurd to pretend, as Senator Spence of Missouri has done, that the question can be dealt with only by comparing the loss to each nation in terms of dollars and cents. The statistics, however, are of interest. An estimate has been made of the total military expenses, the civilian losses and damage, loans and credits extended, and amounts to be paid in pensions and insurance. From this is deducted the indemnity paid and to be paid by Germany, giving a net loss, or war cost, to the United States of \$41,873,948,225; to Great Britain, of \$41,202,634,000; and to France, of \$38,272,915,000. An analysis of these figures shows that the United States is credited with all the normal cost of the War, plus \$1,468,512,225 for Red Cross and other contributions, plus Government loans to European nations amounting to \$9,760,000,000. Great Britain's war cost is estimated by deducting its pre-War indebtedness from its present national indebtedness, plus added taxes, civilian damages, and pensions account. France's cost is estimated in the same way. The yellow press, always to the front when an opportunity presents itself to infer duplicity and cunning

on the part of the Allies, is invariably untrammelled by facts. A leading editorial in a recent issue of the 'New York American' states that "our War debt plus our \$10,000,000,000 foreign loans make roundly \$35,000,000,000. The chances are slight that any of us will live to see these foreign loans repaid. In which event we shall have to pay the \$35,000,000,000 ourselves". The 'Wall Street Journal' shows that this is a good example of 'popular' figures in 'popular' journalism. Mr. Hearst, it remarks, does things on a big scale, and a book-keeping entry making an error in the balance-sheet of \$20,000,000,000 is neither here nor there in that great mind. Taking \$25,000,000,000 as the amount of our national debt, that will be the extent of our obligation if our foreign debtors never pay a cent. In other words, we raised \$25,000,000,000 among ourselves, and we lent \$10,000,000,000 to our allies and associates. In the somewhat remote event of their discharging the entire obligation, our net debt would be \$15,000,000,000 and not \$25,000,000,000, as the people's book-keeper supposes. The 'Journal' concludes by saying that there is no need to analyze the rest of the nonsense about the total cost of the War, which would, perhaps, have been less burdensome but for the unfortunate activities of Mr. Hearst and his friends; for example, if his untimely efforts had not resulted in the conversion of the 'Leviathan' from an asset of \$3,000,000 cash, into a liability of \$780,000 per annum. We lost 78,000 men in the conflict, Great Britain lost 750,000; France, more than a million men. This was the real price of victory. If the question of the cancellation of any of the war debts is to be considered in the light of a moral obligation or as an act of generosity, then it should be borne in mind that the Allies in Europe have lost far more than any increase in their national debts can indicate.

Alaska Juneau

In this issue we publish a detailed description of the Alaska Juneau mill by Mr. V. C. Clauson. This article by the superintendent of the mill gives not only the technical details of its equipment and operations, but also information concerning changes in the metallurgical practice that have saved the enterprise from failure. The Alaska Juneau undertaking has had its vicissitudes; the recital of them will prove more interesting than would an account of the easy steps of a metallurgical achievement that has suffered no setbacks. Six years ago the mining world learned of an ambitious project in the Juneau district that promised to exceed anything heretofore attempted in the way of large-scale treatment of low-grade gold ore. In our issue of April 24, 1915, we described the plans of campaign proposed by the Alaska Gold Mines and the Alaska Juneau companies, owning adjacent properties along the gold belt on the mainland opposite the Treadwell mines, which had made a record for the successful exploitation of large masses of low-grade ore. The Alaska Treadwell, one of the three companies operating on Douglas island, had produced, up to the end of 1914, a total of 14,778,074 tons of ore, yielding \$2.46 per ton, from which dividends amounting to \$14,885,000 had

been distributed. Across Gastineau Channel, on another gold belt, were three mines of considerable promise. They shared an orebody of lenticular shape, four miles long and 1100 feet in maximum width. The northern one was the Ebner, the central one the Juneau, and the southern, or south eastern, was the Gastineau, this being owned by the Alaska Gold Mines Company. Each of them had been mined for comparatively medium grade ore; they were to be developed on a scale exceeding even that of the Alaska Treadwell. The Gastineau mill was to have an ultimate capacity of 10,000 tons per day, a profit of 75 cents being anticipated on ore assaying \$1.50 per ton. The Juneau was to produce 8000 tons of selected \$2 ore, from which 70 cents to \$1 in profit was expected. Estimates of the Ebner's capacity were less precise, but a total tonnage of 5,000,000 per annum from the three mines was predicted. Since then the Gastineau has come to grief. It has been acknowledged that its resources were misjudged. In 1917 the production was 2,240,346 tons of ore assaying \$1.103, from which 81.32 cents per ton was extracted, at a total cost of 76.97 cents per ton. In 1920 the output was 2,133,458 tons, assaying 88 cents per ton, yielding 70 cents, at a cost of 83 cents per ton. The operating loss in 1920 was \$272,337 and the total loss, including interest on notes, bonds, and debentures, was \$501,570. The Ebner remains unworked. The Juneau got into trouble likewise, but of a different kind. The new mill, having an estimated capacity of 8000 tons daily, was completed in March 1917, but proved a failure, its capacity in any one month of 1917 never exceeding 3833 tons per day. The attempt to reduce the ore from 3½ inches to 8-mesh in one operation by ball-mills was radically bad practice. During the last four months of that year, when the mill was doing its best, the milling cost was 47 cents, the total cost 79 cents, and the yield of gold 58 cents per ton, indicating an operating loss of 21 cents per ton. The fiasco nearly wrecked the enterprise; indeed, it is fair to say that it would have been destroyed if Mr. F. W. Bradley had not assumed personal responsibility for bringing it out of its difficulties. As our readers are aware, the failure of the mill and the attendant financial distress of the company were due, in large measure, to a disagreement between those in control, arising in part from an illness that compelled Mr. Bradley to leave the helm during a critical period and in part from the more flamboyant policy pursued by those who controlled the affairs of the company during his absence. In any event, he made up his mind to resene the enterprise, first, in loyalty to those who had bought the company's shares because they trusted him and, second, in order to save the capital that he himself had supplied. He has put more than \$1,500,000 into the affair in order to retrieve it, at a rate of interest below the market and in bonds not convertible into stock, simply a mortgage, thereby preventing such a dilution of the shares as would have reduced the equity of the stockholders. In this work of resuscitation he has had the support notably of Messrs. Ogden Mills, Bernard Baruch, Eugene Meyer Jr., and Seeley W. Mudd. Mr. Bradley tells us that he has been prompted in his course of action not by

more persistency but by knowledge of the facts and a strong desire to give a square deal to all those who bought shares on the representations of himself and his associates. The task to which he set himself four years ago has been rendered peculiarly difficult on account of the incidence of war, which caused a scarcity of labor, delays in the delivery of materials, and a rise in the price of everything; not to mention the landslide that did serious damage to the mill in 1919. The plant has been changed and re-arranged as described by Mr. Clauson until now it is treating 3600 tons daily. This, it is expected, will be increased forthwith to 7000 tons daily, and eventually to 16,000 tons, but just now it is imperative to halt further enlargement of the mill and to begin the earning of a profit in order to stop the increasing burden of interest due on the working capital already invested. In 1920 the mill received 942,870 tons of crude ore, assaying \$1.09 in gold, from which 305,549 tons, assaying 22 cents, was rejected by sorting, leaving 637,321 tons, assaying \$1.50 per ton. From the crude ore 78 cents was recovered in gold, and 6 cents in lead and silver, a total of 84 cents, at an operating cost of 74 cents per ton. Other charges, including interest, brought the total cost to 91 cents per ton. The reserves of ore are estimated at 300,000,000 tons, assaying 85 cents per ton, from which it is expected that 65 cents will be recovered, at a total cost of 40 cents per ton. It is interesting to note that from 1915 to 1920, inclusive, the Gastineau has produced 10,918,989 tons having an assay-value of \$1.02 and yielding 82 cents per ton. The Juneau, between 1893 and 1920, has produced 3,828,399 tons averaging \$1.11 and yielding 83 cents per ton. The cost of mining (including delivery to the mill) at the Juneau has been reduced already to the remarkable figure of 20 cents per ton, and the milling to 44.63 cents, the average last year; but Mr. Bradley and his brother, Mr. Philip R. Bradley, the resident manager, to whom much credit is due, expect to reduce the cost of milling to 20 cents per ton. At the Gastineau the cost of milling was 27 cents in 1919 and 29 cents in 1920. Moreover, it is stated in the annual report that if the prices of labor and materials had been the same in 1920 as in 1915 the total operating cost of the Alaska Gold Mines Company, owning the Gastineau, would have been 58 cents instead of 82 cents per ton. Thus it will be seen that these Alaskan companies have achieved a technical success of no little interest to the gold-mining industry, even though the roseate predictions of six years ago have failed of fulfillment. The Gastineau has not the tonnage of ore that was estimated; and therefore has failed in spite of a creditably low milling cost; the Juneau has enormous reserves, although of lower grade than was estimated; it remains to be seen whether an orebody averaging 85 cents per ton can be made to yield a profit sufficient to pay a reasonable dividend after making provision for the redemption of the large amount of working capital that has been consumed. It looks as if it might be done; certainly the mining profession is a unit in hoping that it will be done and in wishing Mr. Bradley the final achievement of a great undertaking.



Alaska Juneau Mine

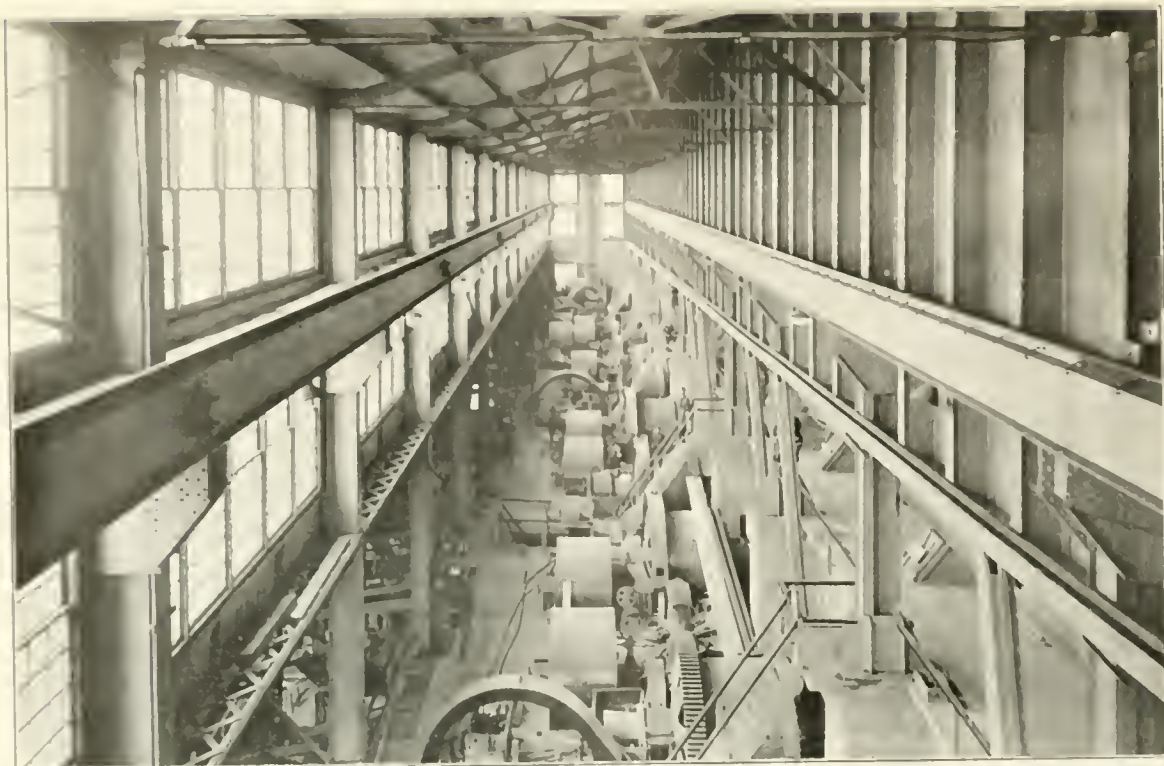
Road to Silver Bow Basin

Alaska Juneau Mill

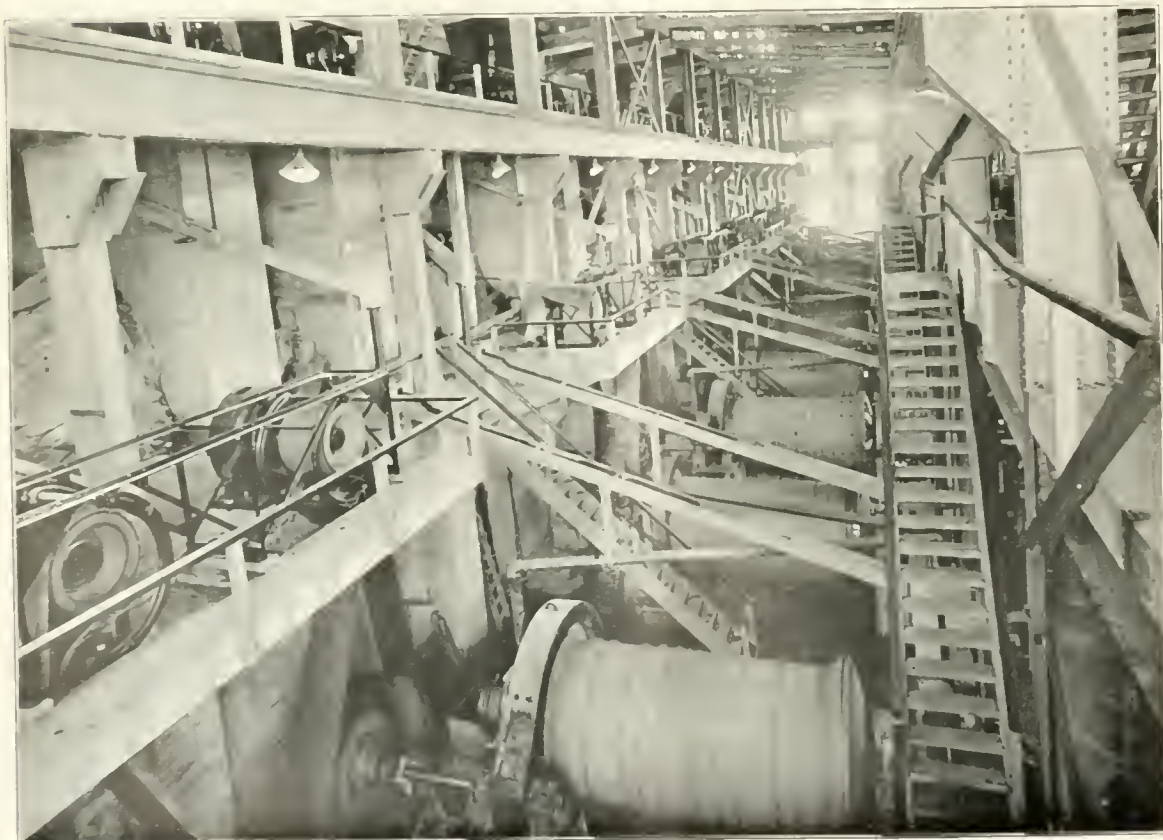
Town of Juneau

Treadwell

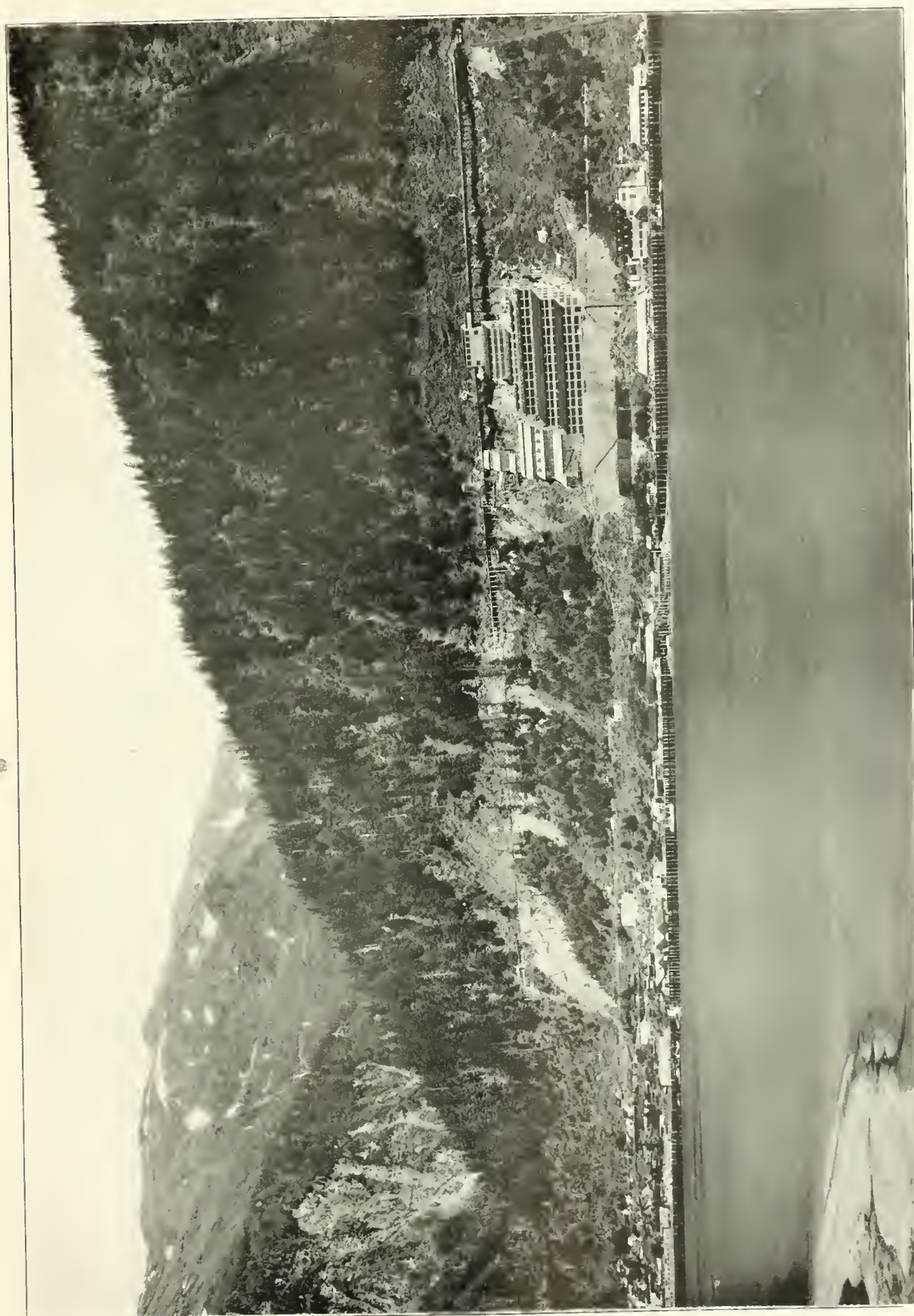
Gastineau Channel



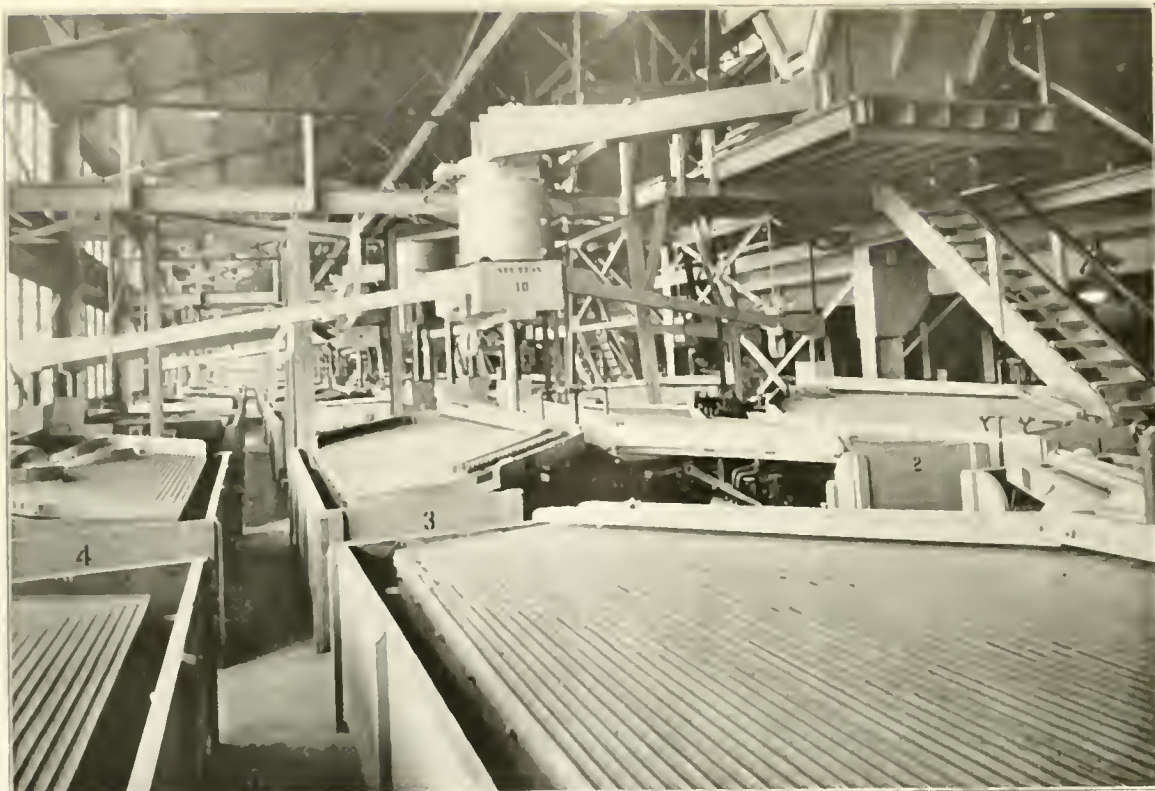
BALL-MILL FLOOR



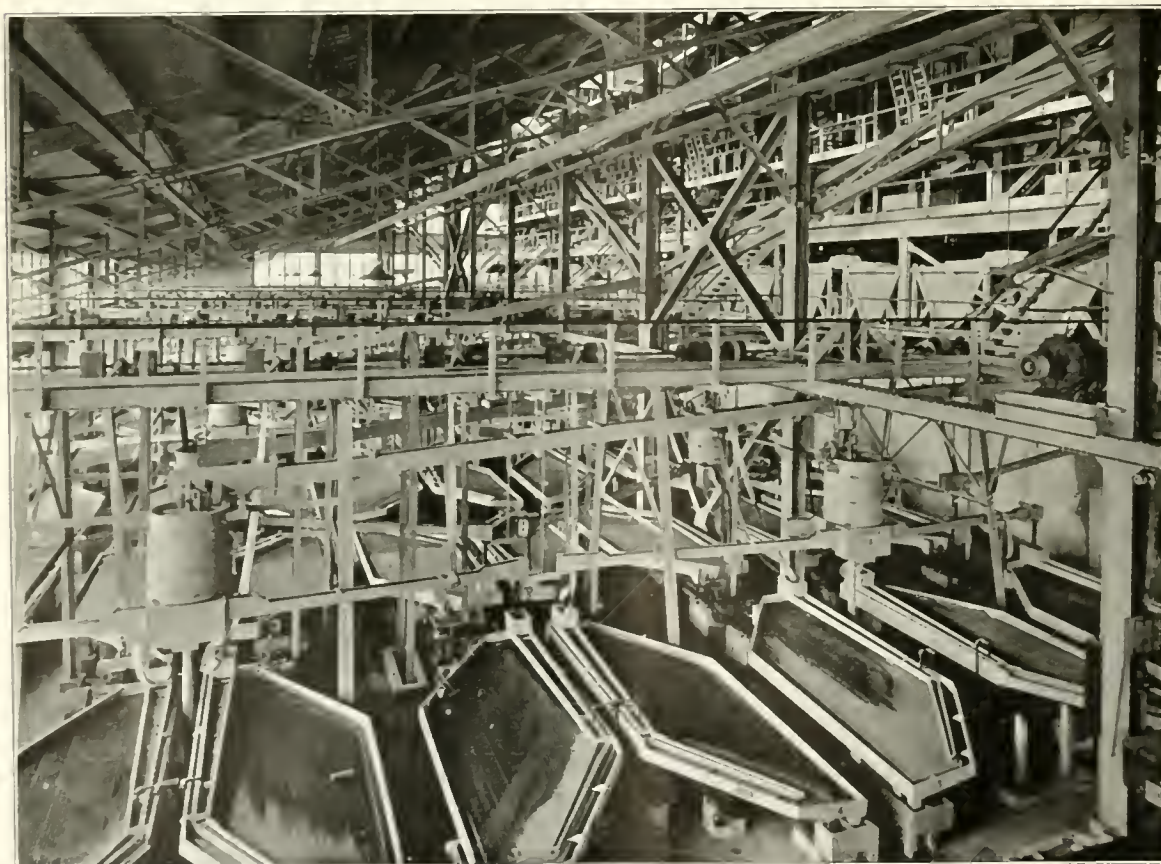
TUBE-MILL FLOOR



Lower End of the Town of Juneau Mouth of Adit to Mine Hospital Pilot Mill The Mill Oil-Tanks Power-Plant Wharf Office



ROUGHING-CONCENTRATION FLOOR



FINISHING-CONCENTRATION FLOOR

The Alaska Juneau Mill

A Record of Events Leading up to and Influencing Its Design and Construction

By V. C. Clauson

EARLY HISTORY. The first discovery of gold near Juneau, in Silver Bow basin, was made in 1880. Placer mining was carried on for a number of years, and in 1886 arrastras were erected to treat the high-grade quartz stringers that were found on the properties operating at the present time. During the following 14 years, several small stamp-mills were erected by various companies; all for the same purpose of treating the best grade of ore, which occurred in the form of quartz stringers.

Early in 1897 the Alaska Juneau Gold Mining Co. was organized and on May 6, 1897, purchased 23 patented claims, which cover the greater part of the total apex of the lode now owned by the company. A 5-stamp mill had been crushing ore from these claims since 1893, and a 30-stamp mill was erected and began crushing in 1895. The ore treated in these mills was mined in open pits from areas showing the greatest number of quartz stringers. A large proportion of the slate and gabbro, which was broken with the quartz, was rejected before coarse crushing, the ratio of waste rejected to ore milled varying from 4:1 to 1:1. From 1893 to 1914, 472,783 tons of ore was mined in the open pits; from this amount 295,807 tons, yielding \$2.26 per ton, was sorted and sent to the mill. For the years 1901 to 1912 inclusive of the above period from 1895 to 1914 of operations with the 30-stamp mill, milling and mining costs, together with the gold recovered, were as follows per ton mined and per ton milled:

Year	Cost of milling per ton		Cost of mining per ton		Yield in gold per ton	
	mined	milled	mined	milled	mined	milled
	c.	c.	c.	c.	c.	c.
1901	20.0	32.9	34.9	55.9	95.4	152.7
1902	16.2	25.9	48.4	77.5	116.4	186.2
1903	17.3	27.6	53.9	86.2	101.4	162.2
1904	15.8	25.2	43.3	69.3	113.2	181.1
1905	13.9	22.3	35.1	56.1	77.4	123.9
1906	10.6	16.9	33.5	53.6	63.4	101.4
1907	12.9	20.6	41.2	65.9	69.8	111.6
1908	13.9	22.2	46.6	74.5	69.4	111.0
1909	14.0	22.4	40.1	64.1	119.9	191.8
1910	13.7	22.0	43.2	69.2	74.5	119.2
1911	15.3	24.5	39.6	63.3	44.7	71.5
1912	14.5	23.2	47.9	76.6	89.3	142.8

As a result of these operations it was considered desirable by the company to tap the ore at a considerable depth below the surface and connect these deeper workings with the beach of Gastineau Channel. Although a number of tentative plans were considered, none took definite shape until 1910. F. W. Bradley then entered

into a contract with the company whereby, for a certain consideration, he would drive the Gold Creek tunnel and construct on the beach a milling plant with a capacity of 23,000 tons per month. He considered the matter as a venture, the success of which depended upon the character of the ore that would be found in depth. If the ore developed in this adit was of the same grade as that which had been mined on the surface, then all-the-year operations could be conducted by a continuation of the established system of open-pit mining during the summer and selective underground mining during the winter.

Up to the year 1907 no company operating in the Juneau gold belt had attempted to mill a large tonnage of run-of-mine. But during the period 1901 to 1905 the Alaska Perseverance Co., under the supervision of the late John R. Mitchell, thoroughly demonstrated that underground mining could be carried on at a profit. Mr. Mitchell succeeded in this demonstration by adopting the Treadwell shrinkage system of stoping and by confining these stopes to a band of the best ore, being a section of the vein 70 ft. wide along the foot-wall. He controlled the output of ore for milling to this 70-ft. section of the vein by doing all drilling and blasting along the foot-wall and by keeping the stopes full of broken ore. He thus prevented an undue portion of lower-grade hanging-wall parts of the vein from caving into the stopes and so maintained the output of milling ore to an average grade of \$1.80 per ton. These conditions led to the erection of a 100-stamp mill, which was operated during summer from 1907 to 1912, when it was destroyed by fire. The results obtained at the Perseverance mine and mill during this period were a recovery from over 600,000 tons of \$1.50 per ton at an operating cost of 20 cents per ton for milling and 70c. per ton for mining and all other local expenditures. It was stated afterward that these operating costs did not exceed a total of 75c. per ton. The Hayden, Stone & Co. circular of October 1914 said in this connection:

"The original estimate of working costs of 75 cents per ton was based to a certain extent on the records of treatment of over 600,000 tons of ore in the old Perseverance mill. This cost was actually attained in that plant in connection with mining only its small capacity of 500 tons daily, coupled with the further disadvantage that it could only operate a few months in the year, due to lack

of power and water during the severe winter months. It is to be remembered that this old plant was located at the mouth of the Alexander tunnel, nearly three miles inland from the Gastineau Channel, and at a considerable elevation, and the effect of deep snows and intense cold made winter operation impossible."

ALASKA GOLD MILL. The operations of the Perseverance 100-stamp mill therefore justified the belief that if milling could be carried on throughout the entire year the mining and milling of run-of-mine would be profitable. On this supposition the Alaska Gold Mines Co. was organized in 1912 and planned to erect at tidewater a mill of 6000 tons daily capacity. The flow-sheet of this mill differed from any of the local plants in that rolls and tube-mills were used in place of stamps, and amalgamation of the total product was omitted. As finally completed in 1915, the mill has a capacity of 9700 tons per day and a normal operating cost of 26c. per ton when operating at two-thirds of capacity.

At the rock-house, the ore-cars are dumped by tipples onto grizzly-bars spaced 10 inches apart, the oversize going to 36-in. by 42-in. jaw-crushers, which crush to 7½ in. The undersize and crushed ore go to screens with 4½ by 4½-in. openings, and the screen oversize is crushed to 2½ in. by No. 8 Type K gyratory crushers.

The ore as thus crushed at the rock-house is conveyed to 1½-in. Impact screens in the mill proper, where the oversize goes to 72 by 20-in. rolls, which crush to 1½ in. This crushed product is elevated by skips, which with Impact screens and 54 by 20-in. rolls constitute a closed circuit that finally delivers all the ore to the concentration bins as a dry product crushed to pass 8-mesh.

Primary concentration is performed on double-deck Garfield tables, sending a rough concentrate to Wilfley tables. The Wilfley concentrate is sent to the re-treatment plant and all table tailings go to 4-spigot Richards-Janney classifiers. First and second spigot products go to 7 by 10-ft. tube-mills and are then distributed with the third and fourth spigot products to secondary Garfield tables. The overflow from the classifiers goes to waste. The secondary Garfield rough concentrate goes to Wilfleys, the clean concentrate to the re-treatment plant, and all the table tailings to waste.

In the re-treatment plant, the concentrates go to No. 5 Wilfleys. The lead and iron concentrates are re-tabled on a No. 5 Wilfley, separating the coarse gold from the lead concentrate, the coarse iron tailing going to tube-mills. Tailing from the primary Wilfleys goes to 3-spigot classifiers. All spigot products go to tube-mills, which discharge into 4-spigot classifiers and thence to tables. Each table makes a concentrate, a middling that is returned to tube-mills, and a tailing to waste. Classifier overflow is thickened and vanned, producing a concentrate and a tailing to waste.

In 1915 the mill crushed 1,115,294 tons at a cost of 30c. per ton; in 1916, it crushed 1,892,788 tons at a cost of 26c. per ton; and in 1917 it crushed 2,240,346 tons at a cost of 26c. per ton.

ORE-DRESSING IN THE DISTRICT. While work had been

proceeding in a desultory manner on the mainland, the Treadwell companies, operating on the opposite side of the Channel, had shown a steady growth. In the year 1882 the first 5-stamp mill was erected; in 1899, 960 stamps were in operation.

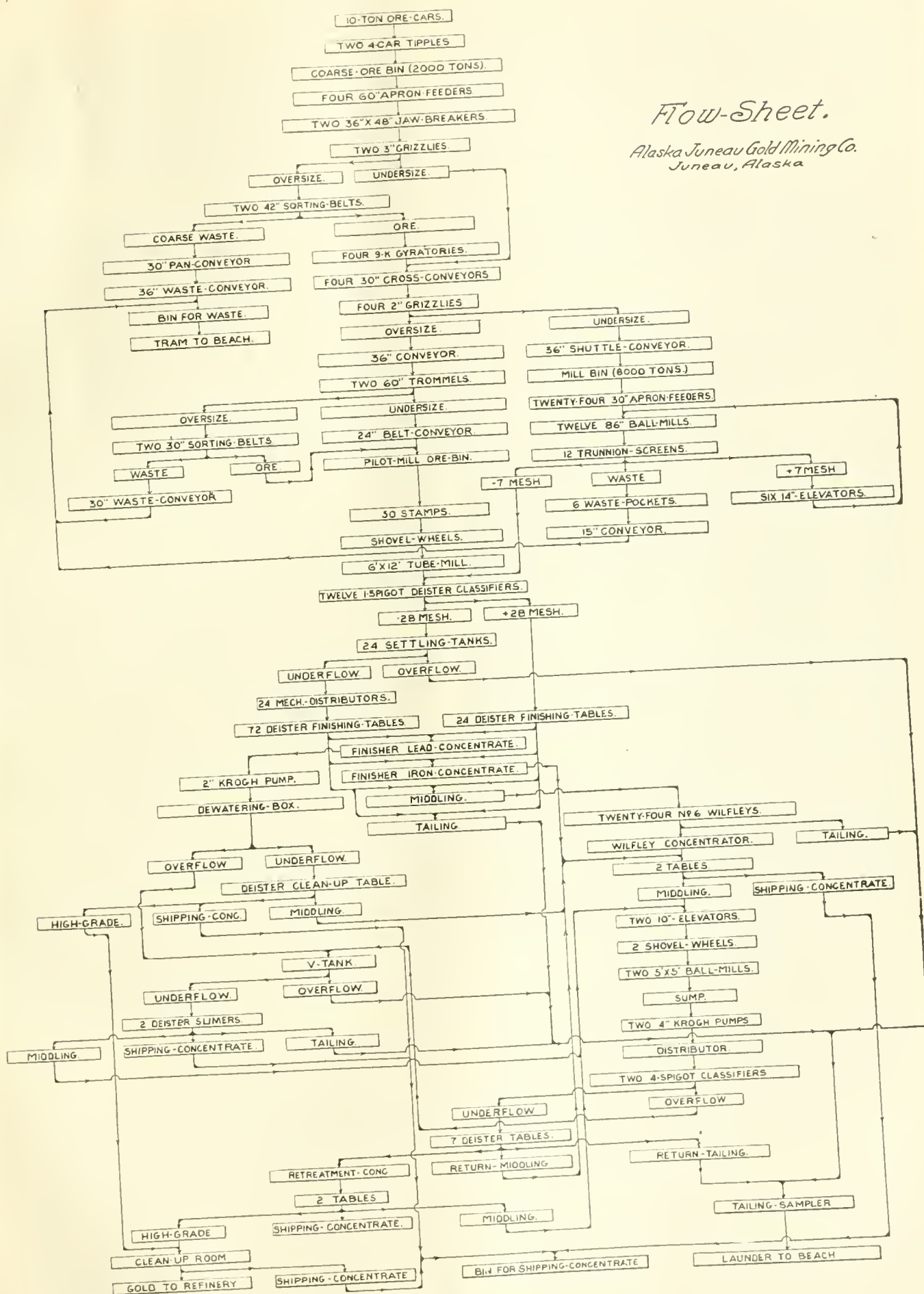
The metallurgical treatment of the Treadwell ore was comparatively simple; it consisted of coarse crushing in gyratory breakers and fine grinding (to 28-mesh) with stamps. Amalgamation of the battery discharge was practised until 1916. The pulp, after passing over the amalgamated plates, was concentrated on vanners. Approximately 50% of the recovery was made by amalgamation. At first the concentrate was treated by chlorination, but after a few years this practice was discontinued and the concentrate was sent to the Tacoma smelter. In 1910 shipments to the smelter were discontinued and the concentrate was treated in a cyanide plant erected on Douglas Island. The excellent results achieved in this plant, both as to percentage of extraction and cost of operation, proved to be a solution of the real metallurgical problem at Treadwell. The extraction for the last two years was 98.75%, based on bullion recovered and tailing sent to waste. The average cost of cyaniding for the period prior to the flooding of the mines was \$3.75 per ton of concentrate.

The use of stamps for crushing the Douglas Island ores had proved them to be so efficient, and their cost of operation so low, that at no time was there any serious thought of scrapping them for more up-to-date equipment. The cost of milling per ton (including coarse crushing, tramming, stamping, and concentration) for three consecutive years in the 300-stamp mill was as follows:

Year	Cost of operation
1909	15.57 cents
1910	17.84 "
1911	18.60 "

ALASKA JUNEAU PILOT MILL. The record of these operations and of similar results obtained in the Alaska Juneau 30-stamp mill and the Perseverance 100-stamp mill, indicated the results to be anticipated at the Alaska Juneau, if work was carried on during the entire year. This information guided the design of the Alaska Juneau 50-stamp pilot mill, which was erected in 1914 on the shore of Gastineau Channel. The original flow-sheet of this mill follows:

Ore was trammed from the mine in 6-ton bottom-dump cars, and discharged into a 600-ton coarse-ore bin. As the ore was drawn from this bin it passed over grizzlies spaced 12 in. apart. The plus 12-in. slate and gabbro was trammed in one-ton cars to the waste-dump, the quartz was crushed in a 6-D gyratory. The minus 12-in. product passed over grizzlies spaced two inches. The plus 2-in. product was crushed in a 6-D gyratory crusher. The crusher discharge and the grizzly undersize passed through a 5 by 14-ft. trommel which was made up of two sections having 2-in. diam. holes, and one section having ½-in. diam. holes. Water for washing the oversize was added in the last section. The minus 2-in. product from the trommel dropped to a 200-ton storage-bin. The undersize from the washing section joined the stamp-



Flow-Sheet.

Alaska Juneau Gold Mining Co.
Juneau, Alaska

battery discharge. The trommel oversize passed to a 24-in. sorting belt, from which the ore was picked and dropped to a 200-ton storage-bin. The remaining slate, gabbro, etc., was sent to the waste-dump. The following results were obtained during the period in which this sorting operation was carried on:

	Trommel undersize	Ore picked from belt	Waste rejected
Percentage of total product	57.63	7.73	34.64
Assay value	\$0.58	\$5.00	\$0.07

The sorted ore was crushed in a 6-D gyratory to pass a 2-in. ring. The discharge from this crusher and the trommel undersize was conveyed on a 24-in. belt to a 1200-ton battery-storage bin.

From this bin each 5-stamp battery was fed by a shaking-screen feeder. The undersize from the feeders (minus $\frac{1}{4}$ in.) by-passed the stamps. The oversize was crushed to $\frac{1}{4}$ in. The battery discharge and the by-passed product passed through a Bunker Hill screen, fitted with 8-mesh wire-screen. The undersize passed over No. 6 Wilfley roughing tables, on which a tailing, a middling, and a concentrate were produced. The screen-oversize and the middling were crushed to 20-mesh in 6-ft. Chilean mills. The discharge from the Chilean mills flowed to Richards-Janney classifiers. The slime-overflow from these classifiers was sent to waste. The spigot discharge passed over separate amalgamated plates and then to No. 6 Wilfley concentrators on which a tailing, a middling, and a concentrate were produced.

In the final flow-sheet the Bunker Hill screen was replaced by two trommels. The oversize (plus 8-mesh) flowed to the Chilean mills, and the undersize flowed to hydraulic classifiers. The classifier overflow (minus 20-mesh) flowed to the desliming tanks. The classifier underflow was treated on No. 6 Wilfley tables, on which a lead concentrate and a middling were produced. The concentrate flowed to the clean-up room and the middling to the Chilean mills. The discharge from the Chilean mills flowed to the desliming tanks. The overflow from these tanks went to waste and the underflow to No. 6 Wilfley concentrators, on which a lead concentrate, a middling, and a tailing were produced. The middling was re-ground in an 8 by 30-in. Hardinge mill and treated on a Deister double-deck slime-table, which yielded a lead concentrate, a middling, and a tailing.

Mr. Bradley planned to increase the number of stamps in the pilot mill from 50 to 150, making it one of four similar units to be constructed when the mine development and the company's finances permitted. These four mills would be sufficient to treat all the ore that would be produced by selective surface mining and underground sorting. This system of mining had been tried and had proved successful, approximately 30% of the broken rock being removed as ore and the remaining waste left as stone-filling.

ALASKA JUNEAU MILL. Before definite plans for the new mill were completed, many glowing reports were circulated, relative to the development work in the adjoining property. These reports (at the time there was no reason to doubt the accuracy of them), together with

the results obtained on the lowest level of the Alaska Juneau, caused the company to change its plans to one of wholesale mining and wholesale milling. On June 4, 1915, the board of directors authorized J. H. Mackenzie, the company's consulting engineer, "to do and perform all such acts necessary in connection with the design and erection of the 8000-ton daily capacity mill already provided for".

At this time two types of mills were in use for reducing local ores, namely, those in which stamps were used and the new mill of the Alaska Gold Mines Co. in which the ore was, at a remarkably low cost, crushed to 8-mesh in two stages by rolls. The adoption of the Marcy ball-mill for the Inspiration Consolidated Copper Co.'s plant attracted a great deal of attention. Mr. Mackenzie became a strong advocate for the use of ball-mills, to grind to minus 8-mesh the discharge from 9-K gyratory crushers. His decision to erect them, for this purpose, in the new mill was made without previous experimental work. I made several requests that a ball-mill be erected in the pilot mill for the purpose of determining the capacity of this machine when fed with $3\frac{1}{2}$ -in. Alaska Juneau ore. My requests were not granted. Correspondence in 1915 indicates that Mr. Mackenzie failed to interpret properly the Marcy data that had been submitted to him by companies using these machines; he assumed the discharge of the gyratories would be minus $3\frac{1}{2}$ in. when crushing Alaska Juneau ore. This proved to be a bad guess, as some of the product was too large to pass through the scoop-feeders of the ball-mills. Furthermore, the mills designed for the Alaska Juneau were not Marcy mills, but a crude, amateurish, and inefficient imitation.

The first section of the new mill was started on April 1, 1917. It was then apparent that the estimated capacity and estimated costs could not be realized without radical changes, not only in the details of the ball-mill design, but throughout the entire mill. On May 31, 1917, Mr. Mackenzie resigned his position as consulting engineer, stating that there was nothing more that he could do for the company. Mr. Bradley then assumed the responsibility of retrieving the enterprise, which was generally considered a failure. The work that has since been done and is being planned for the future is the direct result of his ideas. Some of the defects that have developed and changes that have been and are being made, are described below:

(1) Limited capacity of coarse-ore bin; every delay in tramming causes a shut-down in the coarse-crushing department. Every shut-down for repairs, etc., in the coarse-crushing department causes a similar delay in the tramming department. This condition will be partly overcome by providing additional cars and sidings.

(2) Weakness in design of coarse grizzlies, which were placed between the 60-in. apron-feeders and the 36 by 48-in. jaw-crushers. These failed completely during the first hour of operation. There is not enough room at these points for the erection of substantial grizzlies, and, as a result, the total product from the coarse-ore bins must pass through the jaw-crushers.

(3) Insufficient height between jaw-crushers and gyratory crushers; there was not enough clearance to allow free passage of ore from the jaw-crushers. The grizzlies between the jaw-crushers and gyratories lacked both length and pitch for effective separation of the fine from the oversize. The position of these grizzlies caused the ore to fall into but one-half of the crusher-bowl; this resulted in all the wear on but half the concaves; a decrease in crusher-capacity and breakage of main shafts. These conditions are being remedied by erecting re-designed and re-arranged grizzlies. The grizzly oversize (plus 6 in.) will pass to 42-in. sorting-conveyors from which the ore will be picked, and crushed in the gyratories. The slate, gabbro, etc., will be conveyed to the waste-dump. The grizzly undersize (minus 6 in.) and the gyratory discharge will pass over a second set of grizzlies spaced $1\frac{1}{2}$ in. This grizzly undersize will be sent to the ball-mill storage-bin. The grizzly oversize (plus $1\frac{1}{2}$ in.) will be passed through two trommels having 3-in. round holes. The trommel undersize will be crushed with stamps to pass 1 in. The trommel oversize, after having been washed, will pass over two 30-in. conveyors, from which the ore will be picked, and dropped into the stamp-mill bin. The waste will be sent to a storage-bin, thence to the Gastineau Channel by a gravity tram. The stamp-mill discharge will flow to the new mill, where it will be ground to pass 28-mesh in a tube-mill.

(4) The design of the ball-mills proved to be an expensive experiment and a complete failure. The following are some of the defects that developed and changes that have been made in this department:

(a) The impracticable combination of grates and control screens was replaced by grates having 1-in. openings, and the mills placed in closed circuit by the addition of an elevator between every two mills.

(b) The feed-trunnion is too long and too small in diameter for the successful feeding of coarse rock.

(c) Original scoop replaced by one of local design.

(d) Original feed-spiral replaced by one of local design.

(e) Original breast-liner replaced by one of local design.

(f) Original discharge-cone replaced by one of local design having 100% more discharge-area.

(g) Clutches eliminated from the drive-pulleys and pulleys keyed to pinion-shafts.

(h) Sufficient floor-space for repairs was not provided; in order to operate 12 sections continuously, more space is required.

(i) The crane-carriage in this department does not extend over the feed-end of the ball-mills. Whenever it is necessary to repair or change a scoop, the mill must be removed to a repair-stall.

(5) The operation of the roughing department, as erected, did not prove efficient. No classification was provided: all the pulp of required fineness that could have flowed to waste after concentration was sent to the finishing department, and, without classification, was again treated on the same type of tables as those in the rough-

ing department. The operation of this department was discontinued and hydraulic classifiers placed in the launders leading to the V-tanks in the finishing department. The underflow from these classifiers (plus 28-mesh) flows to the first two tables in each finishing section. The overflow passes to V-tanks, and, after having been deslimed and thickened, becomes the feed for the remaining six tables in each section.

(6) In the finishing concentrating department, four products were made; (a) a tailing to waste; (b) a lead-iron concentrate, which flowed to small storage-tanks, from which this product was loaded into a box-truck and hauled to a point over a hopper into which the concentrate was shoveled. From this hopper the concentrate was fed, by a small shovel-wheel, to a Deister laboratory table, making two products: a high-grade lead concentrate for local treatment and a lower-grade lead-iron concentrate for shipment to the smelter. This method proved to be unsatisfactory, as no control of the grade of shipping concentrate was possible. In order to avoid the labor of handling this product and provide control for the grade of shipping concentrate, the storage-tanks were eliminated and the lead-iron concentrate is now sent to a sand-pump, which elevates this product to a clean-up table, yielding three products: a high-grade concentrate for local treatment, a shipping concentrate, and a middling, which is returned to the re-treatment grinding circuit. (c) The third product, an iron-lead concentrate, was re-ground in a 5 by 5-ft. ball-mill without previous classification; (d) the fourth product, a middling, is re-concentrated on No. 6 Wilfley tables, which produce a tailing and a low-grade iron-lead concentrate, re-ground without previous classification in the 5 by 5-ft. ball-mill. In order to prevent the sliming of the fine mineral in the iron-lead concentrate, a classifier was erected over the shovel-wheel to feed the 5 by 5-ft. ball-mill. The overflow of this classifier (minus 65-mesh) by-passes the mill, and the underflow (plus 65-mesh) is dewatered by the shovel-wheel before being fed to the mill.

(7) Elevator buckets (5 by $3\frac{1}{2}$ in.) in the re-treatment department were replaced by 10 by 6-in. buckets.

(8) The total product from the re-treatment grinding circuit was elevated by a 4-in. Krogh sand-pump to a 4-spigot Deister classifier. The overflow was allowed to flow to waste and the underflow was concentrated on Deister sand-table, of the same type as the roughers and finishers. These tables made three products: a shipping concentrate, a middling (which was returned to the grinding circuit), and a tailing, to waste. The classifier proved to be inefficient, and was replaced by two others of much larger dimensions. A thickener and two slime-tables have been added to treat the overflow, as this product contained a large proportion of free and recoverable mineral. We have also found it necessary to re-treat, on the clean-up table, the lead-iron concentrate produced on the Deister sand-tables in the re-treatment department. For several months efforts were made to produce on these tables a concentrate of satisfactory grade for smelter treatment, but without success. An-

other table has been added to treat the middling before further re-grinding.

GENERAL DEFECTS. (1) The capacity of the mill was dependent on the continuous operation of every department, that is, an interruption in any department caused a shut-down of an entire section. This condition will be remedied, to a large extent, by combining two sections into one unit.

(2) Fluctuating capacity of the ball-mills, due to a large unsized feed, caused erratic conditions throughout the entire mill. The feed to the ball-mills will hereafter be all minus $1\frac{1}{2}$ in.; this will make the capacity of the machines fairly uniform.

(3) The same type of concentrator (Deister Simplex sand-tables) was erected for roughing, finishing, and re-treatment. Classification was omitted at essential points.

(4) It was necessary to enlarge or increase the grade of nearly all the launders.

(5) Failure of concrete foundations under columns supporting the jaw-crushers. It was necessary to place oak cushion-blocks under the columns, as the vibration from the jaw-crushers caused the failure of the concrete.

(6) Failure of concrete foundations under the ball-mill pinion-shaft bearings. This was caused by poor concrete and bolts improperly anchored.

(7) The roofing material (Malthoid) has proved a total failure. We are now replacing it with corrugated iron.

All roofs are too flat for a country that has such a heavy snowfall as Juneau; several roof-trusses failed during the construction period and nearly one-third of the roof over the finisher floor and several sections over the tube-mill floor were demolished.

We have added a salt-water spray system for flushing the roofs during snowstorms.

(8) The friction clutch-drives, which were adopted, have proved a failure throughout the entire mill. Pulleys have been keyed to the shafting, wherever it has been possible to do so; and in places where direct drives are impracticable, we are substituting quill clutches.

(9) Sufficient water to operate the entire mill was not provided. Another 4000-gal. pump will be added.

(10) The tailing-flume will have to be re-built its entire length on account of insufficient grade.

As already stated, the new mill was turned over as completed and ready for operation by Mr. Mackenzie in April 1917. For the first three months of its operation, the average operating costs were 71.71c. per ton. As a milling cost of less than 20c. per ton had been expected this 71.71c. cost was not only a matter of disappointment, but of demoralization as well. Nevertheless a serious and determined effort was made to obtain good results from the new mill by operating it to the utmost capacity that could possibly be secured. In this effort, the maximum capacity attained for any one month reached but 3832 tons per day, as against the promise of 8000 tons per day; and this lack of capacity combined with prohibitive operating costs has constituted a disheartening and costly problem to overcome. The officials of the company have

also been greatly handicapped during the last four years by the shortage of both skilled and common labor, by delays in the delivery of supplies, by the increases in cost of all commodities, and, by more than all else, the slowness in securing funds to pay for the mill alterations.

In the past the mill work has been chiefly experimental. A great deal of time and expense have been devoted to the problem of treating run-of-mine rock in the new mill. The idea of making the mill crush the estimated tonnage has been abandoned and all effort has been directed to the rejection of waste. In this connection, it is interesting to note that the equipment adopted for this purpose is a mechanical elaboration of the equipment erected in the pilot mill for the rejection of waste. When all present construction work is completed, at least 50% of the run-of-mine will be sent to waste, and the cost of milling will be reduced materially.

In the effort to reduce the milling costs per ton, another problem, considering the company's financial condition, has been to make the best use of the new mill as left by its designers. The solution of all these problems has progressed as follows:

Year	Cost of milling per ton mined c.
1918	67.62
1919	56.08
1920	44.63
1921 January	39.06

In other words, after these years of effort, the milling cost in the new mill has been brought down to a parity with those in the pilot mill, which was 39.18 cents for the year 1915; and as fast as the work can be paid for, the altering of the new mill will be continued until its cost of milling per ton mined is eventually reduced to the 20 cents originally estimated.

A QUICK VOLUMETRIC METHOD for the estimation of mercury, by A. A. Hall, is described in the 'Journal' of the Society of Chemical Industry. It is applicable to soluble mercuric salts either in the presence of acid or of any substance unaffected by caustic soda solution, and can also be used in the presence of soluble copper salts and ammonium salts. An excess of an ammonium salt and then an excess of the standard alkali is added to a known volume of the mercuric solution, and the white precipitate formed is made up to a known volume with water and filtered through a dry filter. An aliquot part of the filtrate is titrated with standard acid in presence of methyl orange, and the difference between the amounts of alkali and acid used represents the amount of alkali consumed in precipitating the mercury. If acid be present it can be estimated by titration with alkali before the excess of alkali is added. If the solution contains copper the deep-blue color formed gradually fades as the liquid becomes neutralized.

A NEW APPLICATION for mercury is seen in an attempt to use the vapor for the driving of turbines. The mercury is vaporized in a special apparatus to a pressure of about 10 lb. per square inch. The exhaust mercury vapor is condensed, the steam produced being used to drive a second turbine.



Laws Affecting Oil Exploitation in Mexico

The Editor:

Sir—In your issue of April 9 there appeared an article on 'Reconstruction in Mexico' by 'An Occasional Correspondent'. On page 502 he devotes a couple of paragraphs to what he apparently intends as a summary of the dispute between the Mexican government and the petroleum producers. It follows the government propaganda so closely that one is necessarily led to the belief that the writer has been associated or associating with propagandists or those responsible for the confiscatory legislation, and that his own ideas therefore are simply a reflection of theirs. The statements from "When Mexico" to the end of the paragraph are incorrect and unjust, not only to foreign investors but also to former honest and capable Mexican legislators. They were harmful enough when spread abroad by Carranza and his adherents but when they receive the prestige of appearing in your paper it is time that attention is called to the distorted manner of stating the elements of truth they contain. I shall try therefore to give in this letter a statement of the course of events leading up to the present situation, with as much accuracy as I can in the time and space, omitting much detail and corroborative and explanatory matter so as not to befog the issue.

Your correspondent makes six definite statements:

1. The controversy is whether a nation has a right to control its own natural resources or not.
2. Under Spanish rule all mineral rights were separate from the ownership of the surface and the titles were inalienable national property.
3. The mineral rights of the Spanish crown passed to the Mexican nation when the latter became independent.
4. They have "apparently" not been legally alienated.
5. The law of 1884 was an "attempted robbery" and was not consummated, because it was a legal code instead of a constitutional amendment.
6. The new Constitution of 1917 merely re-affirms the original principles.

I shall endeavor to show that all of these statements are either doubtful or incorrect. He also adds that "like the Bourbons in 1815, the great foreign petroleum monopolists of Mexico have evidently learned nothing from the experience of war". I think they have. I think they have learned that agreements made with a Mexican government are liable to be violated unconstitutionally by some subsequent Mexican government.

The first of the above statements is merely a conclusion drawn from the other five, and stands or falls with them.

To my mind it is not the controversy at all. To me the controversy seems to be whether an agreement with a government or nation is to be kept or is a mere "scrap of paper", and to involve that fundamental of our civilization, respect for a pledge once given. Whether the principle laid down in Article 27 of the new Constitution is the best for the country or not I am not prepared to say, but that the law is confiscatory and retroactive I shall proceed to prove.

By Roman law, mines of gold, silver, lead, copper, iron, and other metals pertained to the owner of the land in which they were found. "*Erant privati juris, et in libero privatorum usu at commercio.*" The Roman emperors, appreciating the possibilities, arrogated to themselves one-tenth of the product of all mines without regard to their location. Spanish legislation, Law 11.^a *titulo XXVIII, Part 3.^a*, enumerates among those things which belong to the emperors and kings "*las rentas de las ferrerías o de otros metales*", that is, mining royalties, not the mines. Still later law, 47 *de tit. XXXII del Ordenamiento Aleala, Novissima Recopilacion*, declares "all mines of gold, silver, lead, or any other material belong to the king and may not be worked without his mandate".*

Thus it is clear that the correctness of the sixth statement depends entirely on the date selected as "original". The statement is also otherwise incorrect.

The tide ebbed and flowed for many years, some kings claiming more and others less until in May 1783 the great *Ordenanzas de Minería* (to which your correspondent refers) were proclaimed the law of New Spain and on January 15, 1784, they were officially published in Mexico by the viceroy, D. Matias de Galvez. This really great code remained the law of Mexico for more than a hundred years because the law of 1884 was in large measure merely a repetition of the principles and provisions of this code and its amendments. According to these *Ordenanzas* the original title to all mines rests in the Royal Crown and without being separated from the Royal Patrimony they may be given into the possession of individuals under the condition that the miner shall contribute a specified portion to the Royal Treasury, and that they must be worked continuously, except as provided, under penalty of reversion to the Crown (*Ordenanzas, Titulo V*). Foreigners were not permitted to acquire and work mines. Clause 22 of chapter VI reads: "I likewise grant that, in the prescribed form,

*Abstracted from the 'Diccionario Enciclopédico Hispano Americano', Mina.

may be discovered, claimed, registered and denounced, not only mines of gold and silver but also those of precious stones, copper, lead, tin, quicksilver, antimony, zinc, bismuth, rocksalt, or other fossils, whether perfect metals or mixed metals, bitumen or juices of the earth, they being given to the denouncer for his enjoyment, benefit, and working, according to the particular circumstances of the case." (Hall's Mexican Law) This is the basis of the case for the present confiscatory claims of the Mexican government, and it is a weak one.

Barba, writing in 1792, enumerates as juices of the earth (*jugos de la tierra*) *asphalto, pissasphalto, nafta* or *oleo petriolo*, jet, maltha, coal, amber, and also salines, alum, etc. This should be noted because of the subsequent association of these materials in Mexican law as compared with the metals. Too much emphasis should not be placed on his statement, because the King in a later decree says that coal is not included in the materials subject to the Ordinances.

A royal order of November 28, 1789, and a *cédula* of December 26, became Law 2, title 20, Book 9, of the *Novísima Recopilación*. According to Hall, it reads: "In order to remove the difficulties that have occurred in the use of minerals of coal and to simplify the method of working them without prejudice to the proprietors and with (!) public utility, I have resolved to declare and order as a fixed and general rule the following:

"1. Coal not being a metal or semi-metal nor any of the other things comprehended within the laws and ordinances that declare the mines and the property of the royal patrimony, the working thereof shall be free and its traffic by land and sea for all the kingdom and its traffic shall not be impeded in order to trade with foreign countries.

"2. These mines ought to belong to the proprietors of the lands where they are, it being understood by proprietor the owner of the fee and not the lessee or emphyteuta, without the necessity of asking any justice or tribunal in order to work them, rent or sell them. . ."

The royal *cédula* of August 1792 declares that the owners in fee of the lands where there may be coal mines can work them, and permit others to do so by renting or selling without more formality than is required by the land that contains them. This was the law of the empire; it was subsequent, and an amendment, to the Ordinances of 1783. It disposes completely of your correspondent's second statement. It also furnishes a precedent for the exceptions in the Law of 1884, and was, I think, the direct cause of those exceptions referred to so harshly in his fifth statement, so before examining the conditions under which the foreign companies acquired their holdings it is well to examine the history of mining legislation a little further. The precedent for the exceptions made has been noted, and it will also be found that under the then existing circumstances the course taken was not only an attempted robbery but was reasonable and perhaps even wise and laudable.

When Mexico became independent the Ordinances and their amendments remained the law, but, contrary to

your correspondent's statement, the mining rights did not vest in the Nation. The official title of a state of Mexico is, or was until 1917, the "free, independent, and sovereign state of"; and this was no mere formality then, whatever it may be now. The mining rights rested, therefore, in the State, and, as a proof of the reality of this condition, some of the states adopted the Ordinances officially, some used them by common consent and custom, and two adopted special codes of their own, founded, however, on the principles of the Ordinances. So much for No. 3.

In 1857 the Constitution was adopted. It contained several interesting provisions and did not contain some others equally as interesting.

Article 14. No retroactive law can be enacted. . .

Article 27. The property of persons cannot be occupied without their consent except for public use and after *indemnización*. The law will determine the authority that may make the expropriation and the requisites that must be verified.

Article 117. Powers not expressly conceded by this Constitution to the Federal functionaries are understood to be reserved to the States.

Nothing was said about titles to the mines being vested in the Nation nor about mining legislation. As all powers not specifically granted to the Federal government remained as attributes of the States the mines belonged to the States and they continued to legislate on mining subjects. Thus your correspondent's fourth statement does not square with the facts, and the difference is important, as will appear.

In 1863 Juarez decreed that "the veins of coal are subject to the mining ordinances". In passing, I wish to point out that his authority to make this decree was very doubtful and has been questioned, although I do not know whether it has ever been ruled upon by any competent court, but at least it was apparently not considered in force a few years later. At any rate in 1881 Sonora made a similar decree declaring "Mines of coal, pitch, asphalt, petroleum, salt, nitre, clay, alum, and precious stones" denounceable under the Ordinances.* The matter had already been brought into court in the case of Don Patricio Milmo v. Don Abraham de la Garza, in which the lower court decided in favor of the owner of the surface and the Supreme Court against him. One of the points was that the King of Spain did not know there was coal in Coahuila, so his law was not applicable to Coahuila, the law having (in the opinion of the judge) been intended for Spain only. However, he overlooked the fact that in 1825 coal mines were discovered in Chile and when the matter was referred to the Spanish government it ruled that "all mines of coal pertain to the dominion of, and are the property of the owner of the land in which they are found". The King's statement, as previously quoted, was clear; it was intended as a general rule.

The State of Coahuila was evidently not satisfied with

*Eduardo Martínez Baca, 'Reseña Histórica de la Legislación Minera en México'.

the decision of the Supreme Court, and, as the same court had held that the several States had power to legislate on the subject of mining, it availed itself of the doctrine and its congress passed a law, which the governor, Evaristo Madero, father of the late Francisco I. Madero, duly promulgated. Following Hall's translation, this reads:

"Article I. The decree of February 25, 1828, and the mining ordinances in the part which declares coal mines denounceable are repealed.

"Article II. The horizontal veins or tables (*mantos*) of coal (*ulleras*), peats (*turbas*), *criaderos* or deposits of petroleum and mineral coal, which may be discovered shall be the private property of the owner of the soil in which they may be found."

If coal was subject to the Ordinances, why the decrees of 1828, 1863, 1881, and others? It is clear that from the time of the Ordinances coal, the hydrocarbons, and salines were considered as differing in their nature from the metals, and that title to mines did not rest in the Nation as far as has been considered, and Federal claim to title in a coal mine was less than doubtful; it was absolutely worthless. It is also clear that President Gonzales had ample precedent for his action. The next question is, was his action justified? The "attempted robbery" is confined to Article 10 of the Law of 1884, which reads: "The following are the exclusive property of the owners of the soil, who may exploit and take possession without the necessity of denouncement:

"1. Deposits of all kinds of coal.

"2. Rocks and materials of the soil as limestone, slate, porphyry, basalt, building stone, earths, sands, clay, and analogous substances.

"3. Substances not specified in Article 1, clause 2, which are found in placers such as iron, tin, and other float minerals. [Bog-iron and stream-tin is meant.]

"4. Salts that exist on the surface, pure and saline waters, whether surficial or subterranean, petroleum, mineral springs, and thermal or medicinal waters."

The only conflict here with the Ordinances of 1783 is in the word "*petroleo*", if we accept the King's statement in regard to coal. "Great aches from little toe-corns grow."

In considering the reason for the above article and the exemptions noted, the object of the law and the condition of the country must be considered. The mining industry was in bad shape and the country as a whole was suffering from the paralysis of all its industries, and the Government was seeking a means of reviving them. In an official report on the subject, D. Miguel Velasquez de Leon says: "In this document are set forth the ideas, which I can only repeat here in a very condensed form, in favor of the absolute freedom of the mining industry, not only as a protectionist measure for a particular industry but as the inexhaustible source of labor, of life and of market for agriculture and other industries."†

On February 29, 1868, a decree was published, part

of which reads: "and adding to this that the mining industry presents a perspective of decadence and annihilation that will soon be complete if the Legislature does not extend a protecting hand to animate it, raise it from the depths to which it has fallen, awakening at the same time in the inhabitants the mining spirit which has almost completely disappeared.‡

Conditions did not improve, so on February 5, 1883, a commission was appointed to recommend what should be done to re-establish the mining industry. The commission reported that the laws should be codified and unified, the industry should be freed from the *alcabala* (a local tax or *octroi*), special taxes, and, above all, from capital taxes; statistics and information should be published concerning coal, petroleum, mercury, timber, water, etc.; foreign capital should be exempted from taxes for a term of years; everything should be done to encourage foreign capital to invest in the mining industry.

At this point the Federal Congress ran into an obstacle. The Nation had no title to the Crown's interest in the mines, and the Federal Congress was not empowered to pass laws on the subject, so a special amendment to the Constitution was passed and ratified by 19 States. It reads:

"Article 72. Congress has the power: . . .

"X. To enact Codes, obligatory throughout the Republic, for mining and commerce, the latter including banking."

Your correspondent is wrong in his fifth assertion. Congress immediately passed the Code of 1884 as recommended by the Commission, and it was promulgated on November 22, 1884, going into effect on January 1 of the following year. It is now apparent why coal and petroleum were exempted from the terms of the code. The Commission had recommended that the laws be made uniform. Coahuila had legally and definitely fixed the title to coal and petroleum in the owner of the soil. Congress could not pass a retroactive law, therefore the only uniform law that could be made was to apply the Coahuila law to all the States. As a further motive there was the fact that desired to encourage the mining industry and especially to attract foreign capital by every practicable means, and one of the recognized methods was to make supplies for the mines as cheap as possible, and to this end coal and iron mines were freed from taxation and it was assumed that leaving coal (and petroleum) to owners of the soil would have the same effect. It should also be remembered that crude-oil residues (*chapopote*) had been traded in from the times of the Aztecs without consideration of the Ordinances and that in 1900 the total value of petroleum produced only amounted to about \$10,000 per annum. The object was to encourage its development if possible.

The Code of 1884 does not state that the title to the mines rests in the Nation. It is probable that the courts would have declared otherwise at the time and that the States would not have ratified the amendment if it had

†Ibid.

‡Ibid.

been believed that such was the intention. The taxes on mines were limited to one tax on products that were to go to the State. The Federal government then collected 25% on this State tax from the States.

The price of silver dropped about this time and conditions did not improve fast enough, so in 1887 (June 6) a law was promulgated freeing coal, petroleum, iron, and quicksilver mines, and their products, from every tax except the stamp-tax for fifty years.* Then the Law of June 4, 1892, was passed "by which the mining property was put on a firm basis and almost on the same footing as other property". Still the article in regard to title, denouncements, and exceptions from the Code remained almost the same as in the Code of 1884.

The encouragement of the mining industry and foreign investment had its effect. According to Baca, there were 4500 hectares of registered mining property in 1892 and 48,692 hectares of special concessions. At the close of 1900 there were 130,978 hectares titled without counting the special concessions. "In the seventeen months from April 1887 to September 1888, 2077 mines and 33 reduction works were recorded."† This was the beginning of Mexican prosperity, which culminated in 1910. The law had had the desired effect.

In 1910 a new mining code was adopted. I refer to it because the commission, in presenting it to the Congress for action, stated: "The law that we have just drawn up is founded on the same principles as that of June 4, 1892. It establishes the same systems but it is new in that it declares that mineral deposits are real property, under the direct dominion of the nation, thus fixing definitely this important point which has hitherto been doubtful". At the same time the law repeats that the following are the exclusive property of the owners of the soil:

1. Wells or deposits of mineral fuels in all their forms and varieties.
2. Sources or deposits of bituminous substances.
3. Sources or deposits of salts on the surface.
4. Surface and subterranean springs of water.
5. The country-rock and substances of the soil such as slate, porphyry, basalt, and limestone, as well as earths, sands, and clays.
6. Bog-iron ore, stream-tin, and ochres.

Thus it is seen that the declaration that coal and petroleum are the property of owners of the soil was no new and radical innovation in 1884; it had perhaps been the law for a hundred years and the declaration was made as part of a campaign to entice foreign capital to invest in the Mexican mining industry. The declaration was repeated in 1892, and for the same reason in 1910, and, as far as petroleum was concerned, in 1901 also. Article 7 of the Law of December 24, 1901, reads: "Land-owners will continue in the enjoyment of the rights secured to them

by Article 4 of the Mining Law now in force and in consequence they may conduct explorations for petroleum and gaseous carburets of hydrogen and may exploit those products as they desire, but with the following restrictions": Here follows references to the police regulations common to all countries.

The "alienation of the national right" was therefore legal, resting on the same foundation as any possible claim for the rights themselves, which in fact seem never to have existed. The rights to metal mines never have been "alienated", but rather seem to have been appropriated under the powers granted by Clause X of Article 72 of the Constitution of 1857.

In other words, for the benefit of the country every possible inducement was offered to get foreign capital to invest in Mexico, much like the talk today, but with substantial reasons added. This was continued up to the time of Carranza, greatly to the benefit of the national prosperity. Looking at the course of events in the petroleum industry, one finds that the Ebano field was discovered in 1901, the production of oil that year being a little over 10,000 barrels. In 1910 the production had risen to 3,643,080 bbl. and the declaration of national ownership of mines (not petroleum deposits) was made. In 1917 it had risen to about 100,000,000 bbl. and it was worth while to discover that the alienation of title was illegal.

Article 27 of the new Constitution states that "All mineral substances in veins, beds, deposits, masses . . . combustible mineral solids, petroleum, and all carbides of hydrogen, solid, liquid, or gaseous, belong to the direct dominion of the Nation".

Article 14 of the new Constitution says: "To no law will retroactive effect be given to the prejudice of any person."

The translations, except where quoting from Hall, are mine.

San Francisco, April 14.

C. A. GRABILL.

Metallurgical Methods at Rio Tinto

The Editor:

Sir—In your issue of April 2, Mr. Van Arsdale discusses metallurgical methods at Rio Tinto with reference to the original article by Mr. De Kalb, in your issue of February 5. The reading of the original and contemplating the conditions submitted, the apparent anomaly between leaching from large lumps, after fine grinding as practised in both lixiviation of copper and gold, affords some interesting suggestions. Mr. Van Arsdale's contribution opens one side of the question that should be discussed fully. There is another side to the 'Why?' of successful leaching as practised at Rio Tinto.

Mr. De Kalb states some facts that, brought together and considered, one with another, lay the foundation for the following queries: In discussing the adaptability of the Rio Tinto ores to the process, he says, "So far as my investigation goes . . . it would appear that the reason

*The statement is made positively that petroleum was included, but I have not been able to obtain a copy of the text of the law to verify it.

†Mines and Mining Laws of Latin America', Bureau of the American Republics.

may be found in the fact that the copper sulphide was introduced by mineralizing agents toward the end of the deposition of the pyrite, if not entirely subsequent to its formation. The copper appears to exist almost wholly in the form of chalcopyrite and secondary chalcocite *following the parting planes of the pyrite*". The italics are mine. Again: "There is evidence to show that, in nearly all cases, the original deposits have been subjected to pressures that have developed fracture-planes, into which later *metal-bearing solutions could readily have penetrated*." "The depth of the piles is variable." "The fine ore *does not yield good extraction*; it yields about 50% of the copper promptly, after which the recovery is slow and the total extraction is most imperfect." "This is in violent contrast with prevalent ideas as to leaching. The ideal usually sought is to ensure intimate contact with an abundance of lixiviant, and to crush the material preparatory to leaching to a finely granular condition." "More recently, as seen at the Ajo mine in Arizona, the ore is crushed only to about $\frac{3}{8}$ inch, with considerably coarser material going to the vats. The lixiviant penetrates these relatively large ore particles, resulting in complete extraction."

A significant feature, emphasized by Mr. De Kalb, is that the formation has been "subjected to pressures that have developed fracture-planes". The copper ores occur "following the parting-planes of the pyrite". Possibly, through the same process by which the large lumps are leached in the heaps, the copper, with the other metals mentioned, originally in the pyrite, found its way to these parting-planes from within the pyrite itself and was there deposited. Dissolved in the pyrite, this would require infinitely more time for accomplishment.

Release from underground pressure would have a tendency to expand the fracture-planes mentioned, also any other interfacial, contact, or cleavage planes, which would be accompanied by an indrawing of the water of combination, ground-water and air, with resultant chemical activity. It is inconceivable that penetration of moisture or solution by capillarity, as suggested by Mr. De Kalb, dissolution of the metals and discharge of the saturated solution, by the same means, can account for the relatively rapid leaching of the heaps, or that it can be effective between periods of flooding and aeration.

Let us assume a capillary channel, a fracture-plane from which the pressure has been relieved, one of the multitude which penetrate the mass of ore in all directions and connecting with the surface of the mass. The rock moisture drawing farther within is followed by the vein water containing dissolved salts, acid, and air, as the case may be. In the heap, the mass is moistened but surrounded by air. With the inception of chemical activity the dissolved metals are in suspension in this occluded moisture. Is it essential that the moisture, with its dissolved metals, should travel to the surface to deliver its burden? Or, the solution toward the centre having become saturated, may not the metallic atoms set up a circuit, through the fluid, to the surface with a counter-current of the active reagents, to the interior? Once at

the surface the metallic salts are carried away in the wash-waters, or, by evaporation, are concentrated until the next flooding. The intermittent flooding affords opportunity for aeration (supplying oxygen) aside from supplying a less volume and stronger liquor for the precipitation plant.

The effect of excessive oxidation, in production of insoluble compounds, will be more apparent when leaching in the open atmosphere, a condition that, as the particles are reduced in size and the surface of a given weight of ore is increased, is enormously augmented. This probably accounts for the less satisfactory leaching of the fine in heap-leaching.

In contrast with this is the practice of fine grinding and leaching in solution. The atmosphere is excluded by the solution. Time, another factor in the consideration, and direct contact with the solvent, to the exclusion of oxidizing agencies, are substituted for the concentrated chemical action in the confined channels in mass-leaching.

Though not familiar with the Ajo ore, I take it that alteration, a dry climate, and mining above water-level supply a somewhat porous unsaturated ore, capable of absorbing the water and contained solvent. Once saturated, the migration of the dissolved metallic particles through the absorbed solution to the main body of solution is set up and maintained as suggested above. This continues until all the soluble metal is transferred to the outside of the particle of ore. On this theory, washing would be only necessary or effective, in removing the metal-bearing solution from the surface of the particles.

On the hypothesis stated, we should look for an ore that has been subjected to pressure and fissuring with resultant separation of cleavage-planes and crystal-faces and in which the present place and state of the bulk of the valuable metals is that of re-deposition in the fracture and interface planes, to be favorable to mass-leaching. This, copper, ore is secondary. Its origin may be primary with the sulphide mass, or, as Mr. De Kalb suggests, of post-mineral, post-fracturing introduction from other sources. The interfacial deposits are, within themselves, self-leaching when subjected to natural oxidizing conditions, so they need not necessarily depend upon reactions in the pyrite. Shrinkage of weight in the heaps is estimated as "rarely in excess of 10% of its weight by oxidation".* Some of this loss would be due to the leached metals with their associated iron and sulphur, together with other dissolved elements. The enhanced sulphur content of the heaps, after leaching, can be attributed, to a large extent, to basing the assay on the residual, 90%, weight, after leaching. It is also possible that replacement of the dissolved ores by pyrite, cementing fracture-planes, may be a factor in the increase, at the same time leaving the mass of pyrite unchanged to all outward physical appearance.

In his article 'Pyrite in the Huelva District, Spain',† Mr. De Kalb mentions the fact that there is little change in the grade of the ore from the upper to the bottom

*M. & S. P', Jan. 22, p. 126.

†M. & S. P', Jan. 22, p. 129.

levels, over a range of 1200 ft., vertically. He observes the surface cross-cut at the Herreras mine, noting the same conditions on the lower levels of the San Dionysio. With the opinion of others in mind and his own observations, he speculates on the decrease of copper tenor as depth is gained. The observed facts point to the conclusion that the copper was primary with the pyrite. Fracturing induced conditions favorable to leaching of the pyrite (FeS and FeS_2) but limited the migration and re-deposition to the fracture and interface channels within the mass of ore, whether pyritic or silicious. Under this supposition we would not expect the copper content to change materially.

Following the suggestion afforded by the heap-leaching, it is but a step to visualize an elevation of the country, or, through erosion, depression of the dead-water level, either setting up circulation of the ground-water in the shattered pyrite lode. The first stage having been completed, in the migration of the copper and other elements to the compression fissures, the second stage would now be advancing; circulation with consequent oxidation and leaching ultimately leaving the pyrite, depleted of its copper, silver, and other soluble ores, a 'pyrite zone', the metals having migrated to a lower zone of 'secondary enrichment', or, possibly, to other formations more favorable to re-deposition.

A section sawed through a mass before leaching and others of other masses from the leach-heaps after several periods in the heaps, polished for microscopic study, would afford some interesting comparisons.

Helena, Montana, April 5. L. S. ROPES.

The Affinity of Oil for Mineral

The Editor:

Sir—It has been decided that the affinity of oil for mineral is a discovery that cannot be patented. What is the affinity of oil for mineral? If oil is added to pulp containing a small quantity of mineral, each particle of mineral will draw to itself enough oil to make a film or covering, and when each particle of mineral is thus covered with a film of oil, the mineral will attract to itself no more oil. Because this is a natural law it cannot be patented. The discovery of this law was not made all at once. First it was noticed that oil added to mineral-bearing pulp would adhere to the mineral and not to the gangue, and later it was found that only enough oil was attracted to the ore to form a film or covering. The law of the affinity of oil for mineral in pulp may be stated as the attraction of a limited amount of oil for the mineral, the limitation of the amount being as important a part of the law as the attraction itself. The Supreme Court is reported to have said that the affinity of oil for mineral is a discovery that anyone may use, but has qualified this by stating that anyone using this discovery must use an amount of oil greater than the mineral has an affinity for, or pay the Minerals Separation people a royalty.

If it is possible for the Supreme Court to be mistaken,

it would appear that the Court is in error in ruling that anyone may use the discovery of the affinity of oil for mineral, provided he does not use the amount of oil for which the mineral has an affinity. This is denying in practice what is granted in theory.

Salt Lake City, April 22.

H. W. REED.

The Colombian Treaty

The Editor:

Sir—In your issue of April 23, you have an editorial upon the Colombian treaty. In this editorial you make some statements that, in my opinion, are grounded upon an insufficient information with regard to the attitude of the Latin-American republics toward us in this matter.

As a result of some years experience and travel, not only in Colombia, but also in three or four other South American republics, I have come to an entirely different conclusion. From the very concise history that you have given of the proceedings which resulted in our possession of the Canal Zone, under lease from the Panama government, it is evident that the process by which we obtained it is analogous to a condemnation of a right-of-way by the United States. In all cases of condemnation it is customary to pay a proper indemnity.

The attitude of most of the merchants and statesmen of South America, with whom I have discussed the matter, may be briefly stated in this way: Having condemned a right-of-way through Colombian property, partly by virtue of expediency and justice of our cause and partly by virtue of our superior strength, we should indemnify Colombia to a reasonable extent, and the South Americans are practically a unit in the belief that the Colombian treaty should be ratified as originally proposed under the Taft administration. I do not believe that it would in any way lessen the prestige of this country to take this step, and I am positive that it will be of material aid in the continuance of satisfactory trade relations with the Latin republics and in the restoration of their confidence in us, which was undoubtedly sadly shaken by the event and by the tacit assistance which our government gave the newly organized Panamanian government.

Los Angeles, April 25.

CHAS. S. HALEY.

THE stock of copper in Japan is now said to be approximately 30,000 tons and is constantly increasing, owing to production in excess of domestic needs and a decrease in exportation, states a consular report. To mitigate this evil, efforts are being made to develop a demand in China. During March, 625 tons was exported for use in the Chinese arsenals and mint. A like amount is usually exported to India, but owing to present stocks now held there a satisfactory trade cannot be developed at present. In the meantime producers are being sorely pressed to continue operation without sustaining a loss.

INDIA is to have a School of Mining and Geology at Dhanbad, in the province of Chota Nagpur.

Mining as a Business

By H. Foster Bain

*When a young man graduates from a school of mines the first and most pressing problem he has to face is usually that of getting a job. I prefer this humbler phrase to the loftier 'obtaining a situation' since it is a well established and valuable tradition that to come to a really responsible position in our profession a man should begin well down toward the bottom and then work, not be pulled, toward the top. Getting a job is a feat of salesmanship and so the young graduate is at the very beginning of his career faced with the fact that mining is a business as well as an 'art and a profession', to quote from the dictionary. So far you have been learning, in the main, the scientific and engineering phases of your future work, which is right and proper. A good school is the best place to learn such things. The facilities for such learning are better than you are likely to have later and the surroundings are incomparably better for getting at the fundamental facts and underlying scientific principles that you must regard in your work. There is, though, another side to mining, and it is one with which you can best become familiar after you leave school. It is the business side of mining, metallurgy, or economic geology, whichever of the three great branches of your profession you choose to follow. The English language does not seem to provide a word which exactly covers this idea, since a 'business' is essentially merely what you are busy with. 'Commerce' might be a better word since it carries both the idea of buying and selling and of traffic, and, better still, since it is defined to include 'dealings between persons and groups of persons', 'interchange of ideas', and similar matters only secondarily related to barter of materials. On the whole 'commerce' or 'commercial' is probably a better word but while shades of meaning are, like flavors to food, worth attaining, it is not well to spend too much time on refinements only, and behind the broad general understanding of 'business' there is ample warrant for discussion of the matters that I have in mind to suggest to you today.

In addition, then, to those facts and principles you have learned regarding materials and forces, there is another lore before you—the always changing, perpetually renewed, problem of applying your knowledge to concrete sets of conditions among men and women as they actually exist in the world. We may make a chemical analysis of a mineral and feel some satisfaction in the result but similar methods applied to workmen would leave us still in doubt as to how to select men for positions, how to pick from among the mass of workmen the particular man for a bit of work. We may test the power of a motor and can start and stop it but who will presume to say what a

woman will do? Yet when we mine we live and work among men and women and they help or hinder our work. Clearly they must be taken into our reckoning, even though this may mean the adding of another x to the equation.

Leaving for the moment the x 's, mining, as it is true of other industrial undertakings, may be resolved into a series of M's, namely materials, men, money, movements. To a considerable extent schools concern themselves mainly with the extremes of this series, the materials and the movement of materials. In your courses in chemistry, mineralogy, and geology you have learned much regarding the materials with which you are to work. What is probably much more important is that you have acquired knowledge of the sources of information and now know something of the dangers of incomplete knowledge and of how to fill in the gaps when need be.

Assuming, as seems safe from your presence here today, that you have been interested and active in learning while in school, you have then a good foundation of knowledge of the M's at the extreme of our series; of materials and of how to put them into motion or to stop them when in motion. It is valuable knowledge but hardly a complete equipment for life, much less so for one who aspires to a position of responsibility among men. Do not ever mistake the mechanism of knowledge for knowledge itself. It was Booker Washington, I believe, who first told of the negro who on observing a white man write a check which passed current as money, resolved to get an education so that he, too, could write checks and not have to work. What you learn in school is not so important as learning to use what you know, and in a world of men—here we get back to our x —influenced to a large extent by considerations that may be measured in money, one is not always entirely free in the choice of applications for his skill and knowledge. Perhaps, though, you have learned about men. I use the term men in its generic sense to embrace women also, and about money. It does happen. In spite of rules, regulations, and schedules, in spite of requirements and electives, some students do get an education. There is something in life itself that draws out certain powers and enables us unconsciously to build ourselves up. Frequently I have been astonished by the excellent results flowing from a course made up, let us say, by selecting History of Art, Slavic Literature, Irish History, and perhaps Medieval French. It is an unexplained phenomenon but some people do get a good education out of such a course. Dean Shaler's story of a young man preparing for business who took Music, the Bible, Greek A, and one similar course—on the basis that these were all given on the first floor with no classes before 10 A.M. and none after 12—may possibly point the

*Address delivered before the Michigan College of Mines, at Houghton, on April 14.

way to wisdom. I can only infer with Simeon Strunsky that so long as young Billy comes into contact with enough material of varied sorts, his active brain will some way achieve an education and no school can hurt him much.

Management is not a thing which can be successfully reduced to rules and text books. In this it differs from chemistry and physics. Imagine, if you will, the difficulties of a chemist working with materials each of which had an independent will of its own. It might well happen in such a world that HCl and CaCO_3 would lie down peacefully together instead of immediately beginning the effervescence we have learned to expect when they are brought into contact. It is this uncertain element common to us all that introduces x into our equations when one attempts to reduce management to formulae. With due reservations, some statements may nevertheless be made, they being, like the maxims of Hafiz, founded on experience.

And the first is that accurate analysis of the matter and careful classification of the work is extremely helpful if not prerequisite to good operating. Men generally dislike to do work that they feel belongs to others. It seems to run counter to an inherent sense of right. Ask a child to put away toys left strewn around by brother and sister and he usually objects; ask one workman to tidy up an engine room or shop left in disorder by the man on the preceding shift and he generally feels imposed upon. So, too, the correlate is true. Men do not like to have others mess into their own working place or work. The sense of proprietorship is strong, even toward a job, and a workman, when given something to do, resents having others between him and his work. The better workman he is the more he resents it. Good workmen are valuable and to keep them satisfied goes a long way toward building up that smooth working organization that is reflected so satisfactorily in the cost sheets. Before assigning work, therefore, think it out. Determine its relations to other work and plan the relations of the men in the job to each other so that each feels a definite responsibility for and the proprietorship in a particular piece of work and arrange the sequence so each helps the other. Few things so slow down the speed of a crew as for the men to feel that they are hindered by failure of the others to perform their parts in proper sequence or by misunderstanding of what is the part of each.

A good workman loves good tools. This has become proverbial. I would add that association with good tools tends to develop good workmen. It is like other such associations in exerting a reflected benefit. So far, therefore, as conditions permit provide your men with the best tools adapted to the purpose that your funds will provide. They will do more work, will be more contented, and will take more care of the company's property. It is frequently worth money to respect their prejudices as to minor tools though standardization is a ready way to reduce costs where it can be effected. As to minor tools, shovels for example, the difference in the first cost and in confusion incident to handling is a small item in the cost

per ton of shoveling when measured against the wages paid during the life of the tool.

Watch the handling of supplies, and especially the delivery to men. The mental friction developed through some minor inconvenience results in a surprising amount of heat which often slumbers long unsuspected before bursting into flame. Many thousands of dollars have been spent in perfecting high speed rock-drills. At present many men and many agencies are studying drill steel in the effort to increase efficiency. Yet the cost of supplies is usually less than half the cost of labor in mining and the actual operating time of drills in hundreds of mines is less than two hours per shift. It would seem that time and thought might be concentrated to advantage on distribution of drill steel, to mention only one of the factors involved. Such a matter might well engage the attention even of a young shift-boss, and I can assure you it is extremely likely he would quickly make a record for efficiency.

Steady running is one of the secrets of good work and low costs. A small mill run steadily is more economical than a large one operated intermittently. Until you have experience you will probably have no adequate realization of the cost of stoppage. Bend every energy to seeing that so far as may be provision is made in advance for contingencies. It is irregularities and delay which cost. To avoid them takes constant thought for the morrow as well as for today. To be entirely secure it is well to take frequent thought, too, of next week and even of periods much farther in the future. A full crew working full time is the ideal.

No more interesting task will be set before you than this one of mastering the art of management. It is a hard rule in life, but you must follow if you cannot or will not lead. In the ideal conditions most of us find our place between, following the greater leader and having our own followers. It was Ruggles, I believe, who expressed amazement at a world where there was none to look down upon, but do not mistake a feeling of superiority for the ability to lead. Above all make up your mind not to be the last man in the profession, the one preceded by everybody else. In mastering the wills of others, bending them to your purpose, you will have the joy of attacking a new job every day, for each man differs from his fellows and each is potential of much good or bad. Let it be your part to increase the former.

One last M remains for discussion, that is money, which is at once a prime requisite to mining and a prime object of mining. From the day the prospector begins to assemble his kit to the final delivery of the last bar of metal, money is essential to successful mining. For a time credit may be substituted, but the life of any enterprise, mining or other, is limited if there be no real money back of it. Mines are seldom self-sustaining from the first. Like children, there is a period when they need nursing before they may be expected to become earners and to attempt mining without making adequate preparations for seeing the enterprise through this preliminary stage is to court disaster at the beginning.

Where does the money come from? Its sources are many and various. In general, the larger sums brought together for financing mines come either from mining companies which are going concerns or from individuals who have already made money out of mines. It is the usual case of reinvestment of earnings in industry. Here, as elsewhere, actually little money is taken out of the industry save as wages and salaries; the greater part of the remainder is promptly reinvested in the industry itself, or was until the present era of high taxes diverted a large portion into the treasury for general purposes. Mining men, as well as others, have now the problem of financing their ventures without being able to command the returns which were formerly the main source of supply. There is one compensation in that the terms of the new tax laws, though discouraging any showing of profit, tend toward extra liberality in operating expense. While this promotes extravagance and waste, it does make possible under good management a policy of betterments and extensions which is strengthening the position of many companies. This, however, does not compensate for the fact that present public policy, coupled with the destruction of the War, is operating to dry up the larger springs from which investment money flowed in times past.

One characteristic of mining which enters into all its financial aspects is the circumstance that mines are wasting assets. The best of mines is finally exhausted and the plant becomes then of scrap value only. Many mines are short-lived and have prospects of notoriously uncertain life. It is frequently, therefore, good mining practice to indulge in what is bad engineering practice. Plants of low first and high operating cost are often unavoidable since one must build with a view to amortization within the expected life of the mine. It may well prove, unfortunately it often does, that the deposit is more extensive than at first appears. Higher operating efficiency or improvements in technology may so lower costs as to permit working lower-grade material and so again lengthen the life of the mine, but there is always an end some time, and this must be taken into account in the plans of a mining engineer to a degree not common in other engineering practice. For each deposit, when its extent and grade are adequately known, there is a definite best life. For certain of the Rand gold mines it was once figured out that the maximum economy was obtained by so equipping the property as to work it out in seven years. Gold-dredging properties are now usually equipped where it is possible on a basis of a 10-year life. After that period a dredge is so worn that it must be rebuilt and this permits easy re-location. This seems to be the controlling factor in determining this term as the economic life of a single unit. Similar figures may be made for other properties when the necessary data are assembled. This is seldom possible with finality because there is in most cases an unknown element as to markets. One usually has to assume some risk either as to over or under equipping a mine. In studying this the facts of obsolescence and deterioration enter. The wear on a metallurgical plant, for example, is so great and progress

of technology has heretofore been so rapid that aside from site and permanent structures, the life of many types of plant is usually less than that of the mines which furnish the ore.

The problem of finances in connection with mining has many intricate but also fascinating aspects. There is the matter of capital versus operating charges and how to allot expenditures to the two accounts. There is no consensus regarding this, and in practice charges are made according to circumstances and the purpose of the accounts. At one colliery that I visited coal was sold on a cost plus basis with the natural result that capitalization was kept low and everything possible charged to operating expense. At many mines where the ear of the manager is keyed to the ticker, every effort is made to swell apparent returns and hence boost market quotations for the shares by charging as much as possible to the capital account and as little as may be to operations. Each course, if pursued to extreme, is dishonest and invites disaster but where there are no recognized standards much must be left to the judgment of the officer responsible and he may properly exercise it with due regard to circumstances, remembering always his responsibility as trustee for the shareholders. The income and profit tax levies in various lands in an effort to pay for the War are introducing order into this chaos and leading to much sound thinking. It was one thing to claim 'an unlimited amount of ore' when selling shares to the public but becomes quite another when arguing with a tax commissioner for a large allowance for depletion. We have all learned much in these recent years and by no means the least advance has been made in the matter of valuing mines.

Many similar problems relating to the financial M tempt one to further discussion but my purpose has been served if I have shown you what a wide field there is ahead for intellectual effort even in the routine of mining. It is with design that I have concentrated my remarks on this branch, not because I do not recognize the usefulness and need of teaching, research, and general examining and consulting work. Good fortune grant the number of teachers and research men continue large. They do us all a splendid service and without them the profession would soon be as lifeless as a mummy, but theirs are special cases and in proportion to the total number of men engaged in mining, the professional teachers and research men will always be small. As to those who engage in making examinations and who offer their services as consultants. I have a deep-rooted conviction that the only safe basis of such work is a term spent in the operating branch of their profession. Go then, I recommend you, into a good operating organization for a while whatever may be your ultimate professional purpose. Merge yourself into it, and learn to do your part. Learn to think of it with the pride with which you root for your favorite ball team. Study it as you do the batting averages and climb in it as fast as your talents and opportunities permit. I shall have failed in my purpose if I have not shown you that this way lies a pleasant and stimulating as well as a useful life.

Cobalt

*The utilization of cobalt in the industries was until recent years restricted to its application in the form of smalt and other combinations of the metal, and the total amount used annually up to 1913 may be estimated roughly at about 200 tons. Its use as an alloy metal in recent years has increased the demand largely, and this should stimulate prospecting work in search of new deposits, especially when it is remembered that cobalt is frequently associated with silver.

The chief minerals of cobalt ores are smaltite, a diarsenide of cobalt, containing about 28% of cobalt; cobaltite, a sulpharsenide of cobalt, containing about 35½% of cobalt; and asbolite or wad, a soft earthy mixture of oxides, containing up to 32% of cobalt oxide. There are numerous other cobalt minerals, including erythrite (cobalt-bloom), linnaeite, and skutterudite, but these are comparatively unimportant. The mineral erythrite is worthy of note on account of its occurrence as a crimson encrustation on many cobalt ores, of the presence of which it thus serves as an indication to the prospector.

Cobalt is used as a coloring agent in several different forms: as smalt, which owes its blue color to the presence of silicate of cobalt; as oxide, which has largely superseded smalt, because of its greater purity, uniformity, and lower cost; and as carbonate, chloride, sulphate, and, less commonly, aluminate, phosphate, arsenate, and nitrate, which are sometimes used instead of the oxide for special purposes, because, when pure, they give better and more uniform coloring. These various preparations of cobalt are used extensively in the earthenware, porcelain, and enameling trades; they are also used for coloring glass, and in the production of various pigments. One part of cobalt oxide to 20,000 parts of glass is sufficient to give it a bluish tinge; a small portion is sufficient to neutralize the yellow tinge that the presence of iron oxide imparts to earthenware and enamels, yielding a pure white color. The addition of cobalt oxide, copper oxide, and pyrolusite to certain waste enamels gives a beautiful black enamel. The colors produced by the aluminate, phosphate, and arsenate, are known as cobalt blue, cobalt ultramarine, king's blue, Thenard's blue, or azure blue, and they possess considerable permanence. Cæruleum, cöline, or *bleu céleste*, has a greenish tint, and is produced by the addition of calcium sulphate or tin oxide to a cobalt solution. Mazarine blue is prepared by the admixture of cobalt oxide with tin oxide, silica, and calcium sulphate. 'New blue', which varies in color from pale greenish blue to deep turquoise blue, consists of aluminates of cobalt and chromium, and is largely used in enamels.

Rinmann's green is a zincate of cobalt, formed by the substitution of zinc oxide for alumina in cobalt aluminate. A green pigment is produced by a mixture of calcined cobalt carbonate, chromium oxide, and alumina. Cobalt bronze, or cobalt-ammonium phosphate, is of a

violet color and bronze-like lustre. Cobalt magnesin pink is obtained from precipitated magnesium carbonate, mixed with cobalt nitrate solution to a thin paste, dried and heated. Cobalt arsenate, if strongly heated and ground, also yields a pinkish-red powder, but red and pink compounds of cobalt are more of scientific than of economic interest at the present time. Blue enamels contain on an average 1% of cobalt, which may be raised to 3% when a dark-blue color is desired. Cobalt oxide in the ground enamel has the property of causing enamel to adhere better to sheet iron; but nickel oxide is usually preferred for this purpose, as it is cheaper.

The acetate, resinate, and oleate of cobalt are very active 'dryers', especially of fish-oil and other cheap oils used as substitutes for linseed oil in paint; their ultimate action upon paint-films is not as harmful as that of some of the manganese-lead compounds. The acetate is easily soluble in warm oil, but most varnish and paint manufacturers prefer the cobalt in the form of a cold-soluble liquid dryer or as a soap such as the resinate or oleate.

In addition to its use as a pigment, cobalt is employed for electro-plating, for thermo-couples, and for sympathetic (invisible) ink. According to experiments undertaken at the School of Mines, Kingston, Ontario, it would appear that cobalt-plating possesses qualities superior to those of nickel-plating. It gives a more adhesive plate, with a more silvery appearance. The conclusions arrived at were:

(1) That cobalt may be plated from four to fifteen times as quickly as nickel, if the proper bath is used. A bath of 145 gm. of anhydrous cobalt-ammonium-sulphate to the litre of water; on one containing 312 gm. of cobalt sulphate, 19.6 gm. sodium chloride, and boric acid nearly to saturation, in 1000 cc. of water, is recommended.

(2) That cobalt-plating is harder than ordinary nickel-plating.

(3) That about one-quarter of the weight of cobalt, as compared with nickel, is required to do the same protective work.

Cobalt deposited in this way is harder and more ductile than nickel, and can be plated on brass, iron, steel, copper, tin, German-silver, lead, and Britannia metal. It has been proposed to use cobalt in the coinage of Canada, to replace the 5-cent silver piece, substituting a coin of pure cobalt, intermediate in size between the 10-cent and 25-cent nickel pieces.

Metallie cobalt, which is a gray metal with a slightly bluish tint, possesses, next to iron, the highest magnetic properties, as well as a higher tensile and compressive strength than any other pure metal. The melting-point of pure metallic cobalt is generally put about 1467°C., as compared with 1435°C. for nickel; but the U. S. Bureau of Standards calculates it at 1478±1°C., several degrees higher than the determination of Kalmus. It has an atomic weight 58.97, and a specific gravity from 8.79 to 8.92. Placet found that the addition of chromium to other metals increased their hardness, toughness, and electrical resistance, but was unaware of one of the chief advantages of these alloys, durability.

*Abstract from a bulletin issued by the Imperial Mineral Resources Bureau, London.

REVIEW OF MINING

A. I. M. & M. E.

The San Francisco section of the American Institute of Mining and Metallurgical Engineers met at the Engineers Club on April 6. In the absence of the chairman, Frank L. Sizer, the meeting was called to order by Edwin Higgins, who presided. The report of the committee upon relations with the central organization was presented by Abbot A. Hanks. This report read as follows:

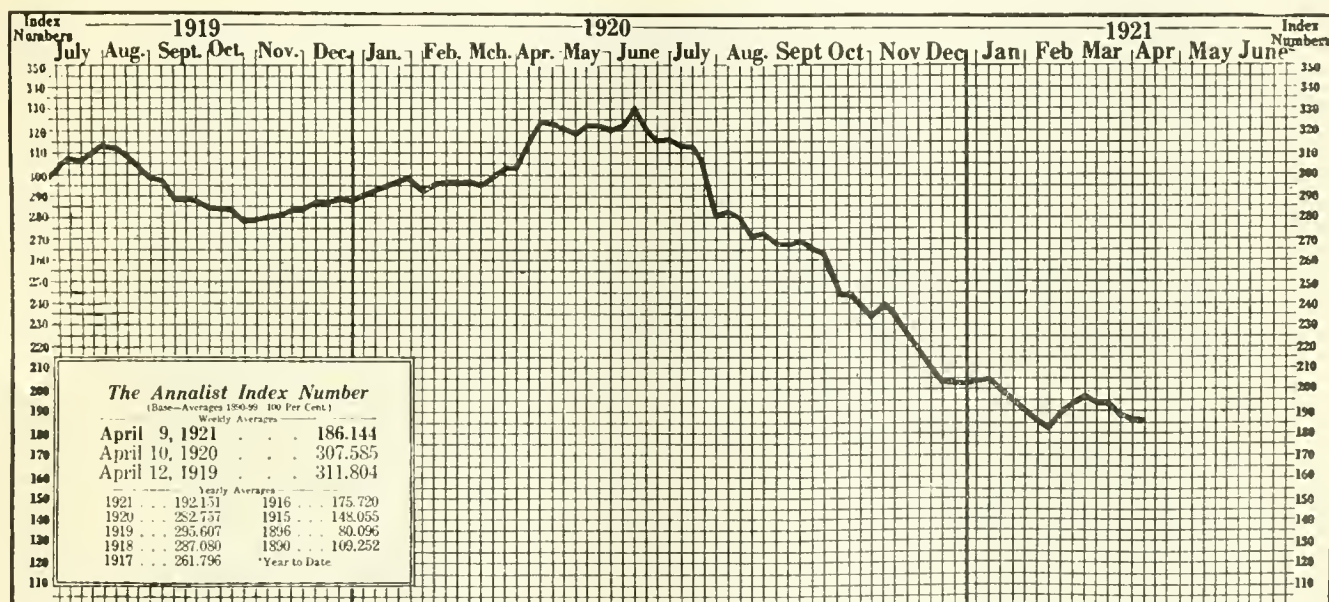
We, your committee, appointed at the March meeting of the section respectfully report our conclusions, as follows:

1. The form used by the Secretary of the Institute in ask-

of the local sections automatically members of the Institute board of directors.

5. In view of the wide distribution of the sections and the distance which separates many of them from the headquarters in New York, we suggest that once a year a directors meeting be held to which the most important questions regarding the Institute's policies should be referred and that an attempt be made to have present a representative of each section even though the expense of such attendance must be met in whole or in part by the Institute or its local sections.

6. In the matter of the request which was made by this Section that a committee be appointed to investigate the Institute's affairs, we regret that the officers of the Institute,



An index number is a means of showing fluctuations in the average price of a group of commodities. The Annalist Index Number shows the fluctuations in the average wholesale price of twenty-five food commodities selected and arranged to represent a theoretical family's food budget.

The Cost of Food. From 'The Annalist'

ing for "voluntary subscriptions" was at fault rather than the principle behind the request. Should it be necessary in the future for the Institute to augment its income temporarily by resort to a similar appeal to the members such an appeal should not be printed upon the regular statement of account for dues and the binding of Transactions, but should be entirely separate therefrom.

2. Rigid economy so far as it is consistent with good service should be practised in the conduct of the Institute's affairs and with this end in view, your committee approves the plan which has been suggested for a classification of publications. Such a plan would enable each member to choose such publications as he might desire and thereby materially reduce the total expense for publication and distribution. A more careful system of editing, also, should result in the elimination of much material which for various reasons ought not to be published in the Transactions.

3. In view of the fact that the monthly magazine 'Mining and Metallurgy', which is almost self-sustaining, gives to our members important news items regarding the activities of the Institute that would not otherwise be available to them we approve its publication.

4. For the purpose of obtaining a more democratic and decentralized system of government for the Institute we approve the suggestions made by former President Hoover that the constitution be so amended as to make the chairmen

after inviting the Section to name the personnel of the committee, saw fit to appoint another one, which in effect supersedes it without first giving the original committee time for organization or action. However, having full confidence in the ability and integrity of the committee which was appointed by President Ludlow, the incident may be considered closed.

Albert Burch
Abbot A. Hanks
Wilbur H. Grant

James W. Neill moved that the publication of the magazine be discontinued. J. M. Hyde seconded. F. W. Bradley supported the motion and made reference to the 'Mining and Scientific Press', which, he said, he had read for 37 years, and which, in his opinion, should not be subjected to the unfair competition of a 'house organ'. C. C. Brayton endorsed this view. Lester C. Uren spoke for the magazine, stating that he found the index of engineering literature useful to himself. The chairman decided that the vote on the motion could be made on the presentation of clause No. 3 of the report. Each clause was then put to the vote in turn and all were carried unanimously except the third,

which was defeated by 18 to 5, several members not voting. The attendance included sundry guests who had come to hear Girard W. Rosenblatt's paper upon 'Electric haulage in metal mines of moderate size'; these did not vote, nor several members from other sections, including Messrs. Sidney J. Jennings and Charles W. Goodale. Mr. Rosenblatt's paper was an admirable treatment of the subject and was well received. The proceedings closed with short speeches by Messrs. Goodale and Jennings, the latter speaking in support of the Pittman Act.

NEW U. S. ASSAY OFFICE IN NEW YORK

The new building to house the U. S. Assay Office at New York was opened on April 4; the delay of several months was due to the mysterious explosion that occurred in Wall street last year. The New York 'Herald' states that the new assay office, which has the distinction of harboring in its underground vaults more gold than ever before has been assembled in one place, is of stone and steel construction, four stories in height, and the last word in office architecture. The first floor houses the cashiers and the weighing room; on the second is the office of Vernon M. Boyle, in charge of the office; A. B. Wilson, chief clerk, and E. J. Wagon, who has been transferred recently to the New York office from San Francisco as superintendent of melting and refining.

The underground vaults, with a capacity of \$5,000,000.-000, the finest the Government now owns, and equipped with all sorts of safety devices and locks, were completed some time before, and the process of transferring the huge store of gold owned by the United States and on deposit here was secretly started. The trip was just across the alleyway from the rear of 23 Pine street to the rear of 25 Wall street, and it was accomplished at night under heavy guard and without mishap. In fact, it was not until the job was completed that the officials of the Assay Office would admit that the gold was under process of transfer from one vault to another.

RESEARCH FELLOWSHIPS AT THE UNIVERSITY OF WASHINGTON

The College of Mines of the University of Washington offers four fellowships in mining, ceramic, and metallurgical research in co-operative work with the Bureau of Mines. The fellowships are open to graduates of universities and technical schools who are properly qualified to undertake research investigations. The value of each fellowship is \$900 per year of twelve months, beginning July 1. Fellowship holders are required to register as graduate students and to become candidates for the degree of Master of Science in mining engineering, or metallurgy, or ceramics, unless an equivalent degree has previously been earned.

The purpose of these fellowships is to undertake the solution of various problems being studied by the U. S. Bureau of Mines that are of especial importance to the State of Washington, the Pacific North-West, and Alaska. The investigations consist principally of laboratory work directed largely by the Bureau's technologists. For the year 1921-1922 the following subjects have been selected for investigation:

- (1) Beneficiation of coal, especially coal washing.
- (2) Electro-metallurgy. Electro-thermic and electrolytic treatment of minerals.
- (3) Ceramics. Survey and testing of the clays of the North-West to determine their economic utilization.

Applicants should send a copy of their collegiate records from the registrar's office of the college where they have been, or will be, graduated. They should also state their professional experience and give the names and addresses of at least three persons who are familiar with the character,

training, and ability of the applicant. Applications are due not later than June 1, and should be addressed to the Dean, College of Mines, Seattle, Washington.

FELLOWSHIPS IN METALLURGY

Invitation is extended to qualified men to make application for fellowships in the Department of Metallurgical Research, University of Utah, during the year 1921-1922. This department is maintained in connection with the Utah Station of the U. S. Bureau of Mines; the work of this department is under the immediate supervision of metallurgists of the Bureau, assigned to duty at this station. During the coming year, 1921-1922, the problems to be continued are the following:

1. General ore-dressing problems.
2. Special problems bearing on the flotation treatment of ores.
3. Volatilization process and its application to gold-silver ores.
4. Volatilization process and its application to lead ores.
5. Volatilization process and its application to copper ores.
6. Hydrometallurgy of zinc.
7. Oil-shale investigations.

The opening affords an excellent opportunity for young men to become experts in the fields of mining and metallurgy and to prepare themselves for highly technical work in these fields. Those who receive this training have been, and are, in great demand at remunerative salaries. There are several fellowships to be awarded, each having an annual value of \$720. These fellowships are open to college graduates who have had a good training in chemistry and metallurgy; applications will be received up to May 15, 1921. Applicants should send a copy of their records from the registrar's office of the college where they have, or will be, graduated, and the names and addresses of at least three persons to act as references as to character, ability, and attainments.

Holders of these fellowships will be subject to the rules governing employees of the U. S. Bureau of Mines and will report for duty about July 1, 1921. They must also register as students in the University of Utah and become candidates for the degree of Master of Science in Metallurgy (unless this or an equivalent degree has been previously earned). Their class work will be directed by the heads of the departments of instruction and their laboratory work by metallurgists of the Bureau of Mines. Fellows are appointed for one year, but the appointment may be renewed. Fellows have no laboratory fees to pay. Applications should be addressed to Joseph F. Merrill, Director of the Utah State School of Mines and Engineering, Salt Lake City.

BULLION STORAGE AT THE CAPITAL

An appropriation of \$2,000,000 to construct in Washington a building for the storage of bullion and currency has been asked for by Secretary Mellon, who says that the present facilities are inadequate.

SALE OF GOLD FROM INDIA

The annual report of the Mysore Gold Mining Co. states that the arrangement entered into with the government of India, whereby the Government agreed to purchase three-fourths of the company's output of gold at the price as ruling in England, two-thirds of the value being payable in rupees and the remaining third in sterling in London, and permitting the remaining 25% to be disposed of in the open markets of India, was favorably reflected in the accounts. The company also had the benefit of the fall in the value of a rupee which in May 1920 was quoted at 2s. 3½d., as compared with the present quotation of about 1s. 4d. The highest price touched for gold in 1920 was £6 7s. 4d. per fine

ounce, in February, as against the latest quotation of about £5 5s.

MINING MACHINERY CONSTRUCTION AND OPERATION

On May 2, through the courtesy of the Sullivan Machinery Co. and its West Coast manager, R. P. McGrath, an interesting motion-picture exhibition was given to the members of the Engineers' Club, San Francisco. The pictures showed the details of manufacture of the well-known products of the company at the plants at Claremont, New Hampshire, and at Chicago. The operation of the machinery was illustrated by a series of realistic photographs that had been taken underground, and which covered the various stages of work in standard coal-mining operations.

WAGE REDUCTION IN CALIFORNIAN MINES

The following revised daily wage scale, representing an average reduction of 50 cents per shift, was adopted on May 1 by mine operators in Amador, Calaveras, and Tuolumne counties, California: miners, \$4; machine men, \$4; muckers and trammers, \$3.50; timbermen and pipemen, \$4; timber-

manufacture of wood pulp or paper or both. The feasibility of doing this has been established by painstaking and thorough investigations and reports made by the company's engineers and by business representatives checked and approved by independent engineers and others skilled or thoroughly informed as regards the wood pulp and paper industry. All this has led to negotiations with responsible people who have indicated their desire to acquire such of the company's facilities as can be used to advantage for the purposes outlined as soon as financial conditions permit. It is impossible, however, at this time even to predict when this may be. Regardless of when or whether this desirable procedure can be brought about, steps have been taken and will be continued after the suspension of mining operations to dispose of the company's movable equipment, such as would not be of use to a pulp or paper mill, as rapidly as it can possibly be done to good advantage.

ARIZONA

Pursuant to suspension orders, Calumet & Arizona furnaces are now idle. Officers of the company state that 550 men will be employed in development work, which will yield



Road Machine Scraping Surface of Searles Lake, Trona, California

men helpers, \$3.75; top laborers, \$3.25 to \$3.50; hoistmen, \$4.25 to \$5; underground hoistmen, \$4 to \$4.25; blacksmiths, \$4.25 to \$5.25; blacksmiths helpers, \$3.50 to \$3.75; carpenters, \$4.50 to \$5.25; timber framers, \$3.50 to \$4; skiptenders and pumpmen, \$4 to \$4.50; tool nippers, \$3.50 to \$4; battery men, \$4 to \$4.25; concentration men, \$3.50 to \$3.75.

CONVERSION OF GOLD MILLS INTO PAPER PLANTS

In the annual report of the Alaska Gastineau Mining Co., the president, Charles Hayden, says that since it became evident during the War that the gold-mining industry could not long survive in the face of changed conditions, including increased costs of operations and multiplied prices for practically everything, except its principal product—gold—constant and vigorous efforts have been made to devise ways and means of realizing to the best advantage and greatest extent upon the large investment in plants, equipment, and facilities of varied kinds. It seems clear that the only way it can be hoped to recover or preserve any great percentage of the value of power-plants and other valuable, but for the most part immovable, facilities is to convert these to the

about 1500 tons of ore per month; this will be stored in the furnace beds. New Cornelia has cut production to 1,200,000 lb. of copper per month, the lowest possible operating basis. Only 300 men will be employed. The property cannot be shut-down entirely owing to the possibilities of serious plant damage through idleness.

CALIFORNIA

Engels.—Reinmiller Copper Co. at a depth of 253 ft. passed through 14 ft. of ore averaging 3.17% copper. Claims are two miles west of the Engels Copper Mining Co.'s property at Engels, Plumas county.

Feather River Copper Co., owners of the Snowstorm group south of Engels in Plumas county, has found in its 1100-ft. adit the downward extension of a 10-ft. vein of good bornite ore found in a short adit 650 ft. above.

Quincy.—The Australia Placer Mining Co. has been operating at its property about 10 miles west of Quincy. It has one Giant monitor running, and is sluicing from 700 to 1000 yards of gravel daily, running three 8-hour shifts, and employing 20 men at the present time.

This property is the old Erickson mine. There is a good

wagon road to the mine, connecting with the main county highway at Spanish ranch. Water is being taken from the Silver Lake region, a distance of 28 miles, and brought to the property by ditch and flumes. Estimates show that this company will have sufficient water to operate until the middle of July or the first of August. Owing to shortage in the past two years, little work has been done. The officers of the company, who are also the directors, are: W. C. Wolf, president; S. J. Wallace, secretary and treasurer; T. F. Hanlon, vice-president. Frank Thomas is superintendent.

Redding.—Analyses made of the silver ore taken from the recent strike in the Old Chicago mine near Igo show that the ore can be treated advantageously by the oil-flotation process.—Sixteen hundred bags will be used in the bag-house of the Shasta Zinc & Copper Co. at Winthrop. They cost \$15,000 and have arrived from Pendleton, Oregon, at the plant.—F. M. Archer, owner of the Chicago mine near Igo, announces that he will put up a flotation plant of 100 tons daily capacity at an early date.—William F. Kett, general manager for the Mountain Copper Co., announces that the company has decided to construct a cable tramline from the Hornet mine to the Southern Pacific at a point a mile and a half south of the station of Motion. The object is to save the expensive haulage over the Iron Mountain railroad. The new tramline is to have an hourly capacity of 100 tons. At present 300 tons of ore is shipped daily from the Hornet mine.

COLORADO

Cripple Creek.—An ore-shoot recently opened at the 2000-ft. level No. 2 shaft of the Vindicator Consolidated Gold Mining Co., Bull Hill, has been drifted for 40 ft. The ore is of high grade but no shipment to test shipping average has yet been made.—The Victory G. M. Co., the lessee of the Howard shaft on Gold Hill, is shipping ore to the Golden Cycle mill.—A test of the Gasche process at the Ironclad mill of the Lincoln Mines & Reduction Co. is under way, under the personal supervision of Thomas B. Crowe and Clark G. Mitchell, Denver, former managing director of the Isabella Mines Company.

Denver.—The Utah Colorado M. & M. Co., owning properties in Clear Creek, Chaffee, and Gilpin counties, and large holdings near Ogden, Utah, is planning development. Ore has been opened up on the Pleasant Valley group on Pewabic mountain. The Utah property has a large tonnage of iron-copper ore, with silver and gold, blocked out for immediate shipment, ranging in value from \$5.50 to \$24 per ton.

Leadville.—The plant of the Western Zinc Co. is to be closed for repairs. Mine operations will continue and reserves will be accumulated.

Telluride.—The flotation plant of the Smuggler Union is rapidly nearing completion; machinery being delivered is installed at once.—The Liberty Bell has been moving and storing machinery and equipment preparatory to closing down.

IDAHO

Three and a half feet of shipping ore has been opened on the No. 4 level of the Western Union Mining Co. property in the Coeur d'Alene recently, according to Ben L. Collins, manager. The raise on level No. 4, 200 ft. west of where stoping has been going on since last November, has broken into good ore. This is the west end of the ore-shoot from which it has been shipping; it establishes it as being at least 400 ft. in length. The ore averages 43 oz. of silver and 53% lead. A strike was also made recently on the No. 3 level, 256 ft. above the No. 4, which latter has a depth of 1200 ft. where the ore-shoot has been developed. Ore is also being shipped from the No. 3 level. A cross-cut has been run 125 ft. to the north and in the next 100 ft. it is expected to cut a parallel vein. D. H. Anderson, of Spokane, is president of the company.

Coeur d'Alene miners will receive \$4.25 per day after May 1; timbermen, \$4.75; mill-men, \$4.25; muckers, \$4; and unskilled surface workmen, \$3.75 per day. This is a reduction of 50c per day to each man. Smelter-men will receive a cut of 75c. per day, which will make their wages from \$3.50 for unskilled labor to as high as \$5.25 or \$5.50 for the more skilled positions.

Work has been resumed on the Paragon mine in the North Fork district of the Coeur d'Alene. During the winter the company's mill has been overhauled. It will not be operated until metal prices improve or until the property is opened to a greater depth. The shaft is down 60 ft. and will be sunk at once to a depth of 300 ft. From this level a cross-cut will be run to the ore, a distance estimated at 200 ft. If metal prices should sufficiently improve before this development is completed the company will begin operations from ore it has above, chiefly in the Black Horse mine.

The Alma Itay Mining Co. is doing extensive development on its claims, two miles north-west of Kellogg, and has 20 ft. farther to go with the cross-cut to cut the vein showing in outcroppings, according to William Simpson, in charge of the contract work. During the last few months 181 ft. of cross-cutting has been done and 70 ft. of mineralized quartzite exposed, carrying both lead and silver. The officers are: R. A. Blockman, president; C. C. Bloomquist, vice-president; C. B. Forbes, secretary and treasurer. These, with W. W. Papesh, Peter Engels, and D. Barnhart, form the directorate.

Salmon City.—Operation of the mine and mill of the Pope Shanon Mining Co. will begin May 4. Miners have already been put to work breaking ore and on May 4 the Bradford volatilization plant will begin treatment. A tramway to carry the ore from mine to mill has also been completed. The mill will eventually have a capacity of 200 tons per day. Additional volatilization units will be installed as speedily as possible after the mill is operating smoothly.

MICHIGAN

Calumet.—Copper production for the month of March by the undermentioned companies was as follows: Ahmeek, 2,573,000 lb., Calumet & Hecla, 5,687,000, and Isle Royale, 887,000 pounds.

Houghton.—Within the last four weeks, Calumet & Hecla has sold 6,500,000 lb. of copper. Germany still continues to be the best foreign customer for the red metal. The Calumet & Hecla smelter and electrolytic plant likely will continue in commission for several weeks. Comparatively little copper was sold by Calumet & Hecla in January and February and the recent sales are encouraging; fully a year's supply of metal is on hand, based on 1920 production, but at the present rate it would not take many months to bring the amount down to the surplus carried in normal times.

Copper Range since the first of the year has practically doubled its underground force at Champion, about 600 men now being employed. Rock shipments from Champion have increased proportionately, and Champion rock shipments average 1800 tons daily; Baltic 700; and Trimountain 400. Champion mill is operating steadily throughout the day instead of only a part of the day, thus effecting a saving of costs, particularly in coal consumption. Since the first of the year Copper Range sales have almost kept pace with production, now about 2,000,000 lb. per month.

The Quincy mine continues to operate the first four days of each week. Quincy, on a 25% production basis, is not making money; the management states that the property is being kept open to help relieve industrial distress.—Mohawk continues to operate at capacity, having a full underground force; Wolverine is maintaining its average. These mines are sending a total of 3700 tons of rock daily to the mills.

NEVADA

Broken Hills.—Stockholders in the Broken Hills are reported to be attempting to wrest control of the company from George Graham Rice. Rice, according to reports, ordered wages at the mine reduced; Edward Malley, president, has refused to do this on the ground that Rice is not an officer in the company.

Divide.—The vein on the 600-ft. level of the Gold Zone, from which shipments were made, has been entered in a 100-ft. cross-cut on the 800-ft. level. The shaft is now being sunk to 900 ft. The Dividend has cut a vein giving low assays on the 200-ft. level, 150 ft. south of the new shaft. The same vein, also giving low assays, has been cut on the 400-ft. level of this shaft. The objective, the Divide Extension vein, has not been reached.

Eureka.—The Croesus and Holly companies have reduced wages 50c., making the pay of miners \$5, of muckers and topmen, \$4.50.

Goldfield.—With higher smelter rates since the closing of the copper mines, the Tonopah mills closed, and high freight rates, the lessees of Goldfield and the small operators of the surrounding territory are practically unable to market their ore. An instance of this is the Great Bend in Goldfield, which, with a \$2.50 hauling charge from Diamondfield to the railroad, a \$5 production cost, and a \$15 freight and treatment cost, would be left \$2.50 per ton out of \$25 ore. The Bend would be shipping but for these conditions.

Johnnie.—A hundred men, many striking miners from Tonopah, are at work in the newly found placer-field near here. Bedrock is a few feet from the surface in places; some of the men are reported to be doing fairly well in the pay-streak, which is less than 1 ft. thick.

Pioche.—Important mineralization has been encountered on the 700-ft. level of the Prince Consolidated Mining & Smelting Co.'s deep shaft. The limestone at this depth is well mineralized with iron, manganese, and silver for a thickness of 8 feet.

Rawhide.—Material for the 25-ton all-slitting cyanide-mill to be built by the California-Nevada Milling Co. is being hauled from Fallon.

Silverhorn.—Engineers from Nevada districts who have visited Silverhorn recently confirm reports of widths up to 75 ft. of low-grade silver ore and declare that in their opinion conditions justify the expenditure of the large sum that will be necessary to prove the persistence of the orebodies. Most of them regard Silverhorn as a field for big operators and do not consider the conditions good for mining on a small scale by companies or lessees. All of them express good opinions of the district, and particularly of the vein in the Silverhorn group, where they say the average content of the ore is 15 to 25 oz. over 10 to 75-ft. widths on the surface. Ore has been found over a length of 400 ft. on what is known as Weir's peak, on the Silverhorn. The principal work being done is trenching and the surface of the vein is being sampled. New companies are being formed, and at several places important underground work has been started.

Simon.—The mill of the Simon Silver-Lead is nearly completed, according to P. A. Simon, president of the company. Surveys are being made for the power line to the mine, and work in the mine has been resumed.

Tonopah.—The offices of the Belmont are to be moved to Tonopah from San Francisco, where they have been for the last four years, or since the operation of a number of subsidiary companies was started. All of these, with exception of that at Surf Inlet, are now closed; the affairs of the Belmont will again be directed from Tonopah. There is no change in the strike situation. Governor Boyle has said he will not intervene unless requested to do so by either side.

Yerington.—The annual report of the Mason Valley Mines

Co., in discussing the rate case, says: "Persistent efforts have been made to obtain a fair freight-rate from points in Plumas county, California, to the smelter at Thompson, Nevada. Plumas county only started copper production a few years ago, but developments have been so favorable that it is now a fairly important producer and will, no doubt, become increasingly so. The ore is practically all concentrated, the product being shipped to Salt Lake Valley smelters. The Thompson smelter is about 500 miles nearer the mines, and with a fair freight-rate and some changes at the smelter, should be able to obtain a smelting tonnage from the district which could be treated profitably."

OREGON

Grants Pass.—A clean-up of the plant of the Boswell Mining Co., after 24 days' operation, has resulted in the recovery of 1805 oz. gold. The ore is milled in a Huntington mill; plates and a Pierce amalgamator are used. A cyanide plant went into operation on May 5, the vats being made of redwood, constructed by the Pacific Tank & Pipe Co. Twenty-five men are employed in the mine. The west drift has a vein of ore that is 4½ ft. wide and averages \$250 to the ton. The ore treated by the mill averaged over \$800 per ton. The property consists of 108 acres.

UTAH

Delta.—Work has commenced on a new molybdenum discovery in the Sawtooth mountains, 55 miles west of Delta. The property is held by R. H. Evans, P. M. Purdy, and others, who are planning to keep six or eight miners prospecting the claims thoroughly. The outcrop, which is well-defined, can be followed for two miles along a granite limestone contact.

Eureka.—Shipments from the Tintic district for the week ended April 22 totaled 120 carloads, as compared with a total of 121 carloads for the week ending April 15. Production was: Tintic Standard, 47 carloads; Chief Consolidated, 32; Iron King, 15; Iron Blossom, 8; Victoria, 6; Dragon, 4; Eagle and Blue Bell, 3; Swansea, 2; Eureka Mines, 1; Alasak, 1; and Gemini, 1.

The Tintic mill at Silver City is preparing to treat a larger tonnage of ore. Two roasters, which have been idle for some time, will be put into commission at once. A large part of the ore which is being handled at the mill is now coming from the Chief Consolidated mine.

While the Grand Central mine is closed-down, lessees will be permitted to operate in promising ground; they are already at work, reaching the Grand Central workings through the Mammoth mine. The ore is being accumulated until there is sufficient to justify the starting of the Grand Central hoist.

Conditions on the 900-ft. level of the Apex Standard mine are promising; two drifts are being driven, one to the east and the other to the west. As these drifts near areas where ore is expected, the formation is showing increased mineralization, according to Lewis Merriman, manager.

The new milling plant of the Tintic Standard Mining Co. is treating 150 tons of ore daily and a satisfactory recovery is being made. About 45 men are now employed at the milling plant, and in the installation of an electrolytic process for the recovery of lead. Although the ore being sent to the mill contains mostly silver and copper, there is also 2 or 3% lead. When this electrolytic process is installed, the Tintic Standard mill will be able, it is hoped, to treat a silver-lead ore. J. B. Haffner, from Ray, Arizona, has accepted a position as foreman at the Tintic Standard, succeeding Singleton Ferguson who plans to retire from mining.

A carload of shipping ore with from 50 to 60 oz. in silver and about 10% lead has been mined in the Eureka Bullion during the week ending April 28; it came from a raise from the 925-ft. level. In a distance of about 35 ft. the ore has

widened from a narrow seam to a 4-ft. shoot. The ore now being mined is in a brecciated limestone on the foot-wall side of a fissure.

Ophir.—Upon breaking into the Huchhorn fissure No. 2, in the Ophir Silver Mines main cross-cut, a full face of ore averaging 11 oz. of silver has been found, according to Guy R. LaCoste, manager. An average assay of the dozen or more high-grade seams in the face show contents of \$16 per ton in gold and 31.6 oz. of silver.

Park City.—Shipments of ore from the mines of the district for the week ending April 22 aggregated 1321 tons, as compared with a total of 1087 tons for the week preceding. Production was as follows: Judge Allied companies, 668 tons; Silver King Coalition, 598; and Ontario, 55.

Salt Lake City.—A resolution endorsing the Pittman Silver Act was unanimously passed by the Salt Lake Clearing House Association on April 27. This action came as the result of an address made by W. Mont Ferry, managing director of the Silver King Coalition Mines Co., on behalf of the silver producers of Utah. Mr. Ferry pointed out the fact that not only Utah but Western business needs the stimulation arising from the execution of the provisions of the Pittman Act.

The resolution adopted by the Salt Lake Bankers Association calls upon Congress to see that the promise made by the Government, to purchase at \$1 per ounce from domestic producers the metal sold to England during the War at the same price, be kept. The resolution also urges Salt Lake City bankers to communicate with their banking connections in the East asking that the campaign of misrepresentation against the Pittman Act be combatted with facts.

Utah smelting companies have notified shippers of ore that the price of silver will be reduced to 99½c. per ounce as compared with 99¾c. that has been paid ever since the Government started to buy under the provisions of the Pittman Silver Act. The reason for this reduction, as given by smelting companies, is that the Government has ordered Eastern handlers of silver to deliver a minimum of 10,000,000 oz. of the metal to the Denver mint. Until this order is filled the slight reduction that brings the price down to 99½c. from 99¾c. will be made to meet the additional shipment and insurance charges.

Operations have been resumed at the property of the Cottonwood Grand Central Mining Co. situated in Big Cottonwood canyon, Mill D flat. Contract for the driving of the adit has been awarded to E. E. Watrous. The adit, which is being driven to open up the intersection of a main north-east-southwest fissure with a lime-shale contact, has cross-cut the formation for a distance of 800 feet.

At the annual stockholders meeting of the Utah Copper Co. on April 22, the directorate was increased from 15 to 17 members. Murry Guggenheim and C. V. Jenkins were the new directors elected.

St. George.—Development work is being carried on by the Silver Reef Consolidated Mines Co. preparatory to the building of a milling plant. The ore found is of a good milling grade, with large lenses of high-grade ore.

Work is being carried on in three old shafts and one new one on the White Reef; three electric hoists and one horse-whim are being operated. The Honest Miner shaft was sunk to a depth of 160 ft. At this level there is about 500 ft. of backs for stoping.

A depth of 400 ft. below the lowest of the old workings in the Cobb shaft has been attained. Work at this new level gives a depth of 900 ft. on the dip. At intervals of 100 ft. in the incline being sunk from the Cobb shaft, laterals, all of which are in ore, are being driven.

WASHINGTON

Spokane.—At the Idaho Gold & Ruby Mining Co.'s property near Bonners Ferry three giants are at work on a high

bar about 1600 ft. upstream from the flumes, construction of which has been practically completed. Water has been turned into both the 6-ft. and 12-ft. flumes, and the fine sand is beginning to collect in a 15,000-ton cement storage-tank. The concentrating plant is to be equipped with Ogden tables, and special gravity devices designed by S. A. Deardoff, the assistant manager. The tables, for which the company owns patent rights, are being constructed on the property; it is said the plant will be in readiness by July or August. The flumes are 300 ft. long, and constructed of cement and heavy timbers.

Activity is apparent in the Boundary district of Stevens county. James O'Brien, William O'Hanlin, Jack Smith, and Patrick H. Graham have taken a lease on the Lead Trust property from Fred Seaman, and two of the lessees are working on the property. They have 300 tons of ore on the dump which they probably will ship to Trail. The ore runs 40 to 60% lead, with several ounces of silver to the ton. —Two carloads of ore per week are being shipped by Gus Maki to the smelter at Mineral Point, Wisconsin. T. S. Harris is manager. The property is six miles from Northport.

Silver Cloud, on Red Top mountain, is a property discovered last winter by Jack Aserford and Cap Hartman, who were grubstaked by Patrick Graham, the storekeeper at Boundary. That the old-time prospector with a grubstake outfit is not a thing of the past and that he still has chances of making rich winnings is demonstrated by the success of these men. The Silver Cloud promises to be a big property. The vein is six to eight feet wide over the entire width, averaging 22.2 oz. silver. The ore has gold and copper. —William and Dave Bechtel are doing development work on their property. They are continuing the tunnel, which is in 700 ft. and which they will extend to cut the vein. —Work on the property of the Northwestern Iron & Steel Co. will begin in a short time, as soon as road conditions warrant.

The Columbia Mining Co. is to purchase a five-drill water-driven compressor. The company holdings include three claims formerly known as the Blue Mountain group, 14 miles from Keller, Washington, and 14 additional claims more recently acquired. The company will extend several hundred feet in the No. 4 tunnel, the face of which has a vertical depth of 300 ft. A contact vein across the property is 40 to 12 ft. wide and a fissure-vein runs at right angles. Both have been developed by open cuts and underground work. The No. 4 tunnel runs in on the fissure-vein which appears to be 35 ft. wide.

Samples indicate a value of \$13.28 per ton. Total work on the property includes 500 ft. of tunnel and 190 ft. of shafts and winzes.

AUSTRALIA

Queensland.—In order to save the wolfram and molybdenum mines near Cairns, the Chamber of Commerce of Cairns is urging the Commonwealth government to acquire the property as a national asset. During the War the deposits were exploited and the concentrate was shipped to the United Kingdom.

Western Australia.—The Imperial Mineral Resources Bureau reports a development on the abandoned Golden Dream lease, about one mile north of Hannan's Reward mine, Western Australia. An auriferous lode has been struck and driven on for 60 ft. over an average width of 2 ft. 6 in., and a trial crushing gave 95 oz. of gold from 88 tons of rock, with 5 dwt. per ton in the sand.

The production of gold at State Batteries since the date of inception to August 31, 1920, has now reached a total of £5,230,839, made up as follows: Tons of ore milled, 1,266,431; production by amalgamation, £4,379,655; by sand treatment, £634,354; by slime treatment, £207,475; and by residue, £9353. In addition, the State tin-treatment plants

have produced by black tin, £92,120, and by residue treatment £572, making a total mineral value from all sources of £5,323,532.

BRITISH COLUMBIA

Ashcroft.—Carl Elingsen and Thomas Lick have disposed of their placer-claim for \$12,000. The deposit can be worked only as a 'dry mine', as it is high up on the banks of the river, near Spence's Bridge, and there are no streams that can be used for hydraulicking or for sluicing. Water for sluicing will have to be pumped from the river. The Pacific Roofing Co. is erecting a calcining plant at its magnesite quarry at Mile 105 on the Cariboo road.

Stewart.—Torger Peterson, of Tacoma, and W. J. Wesenling have located 10 claims surrounding the Commonwealth group and water-rights on Davis creek, and will consolidate the new claims with the Commonwealth. A tunnel will be driven into a body of low-grade ore that has been exposed at the surface. The Commonwealth is situated about two miles from tide-water, on the Alaskan side of the international boundary. Mild weather has again caused a cessation of shipping from the Premier mine. It is hardly likely at this late season that any considerable further shipments will be made until the rope tramway is in operation. A new compressor has been ordered for the Premier mine.

Trail.—The Consolidated Mining & Smelting Co. has just issued its annual report, which shows a net profit of \$291,395, of which interest on the bonded indebtedness absorbs \$251,923. Owing to the excellent condition of the company's mines and plant the directors considered that they were justified in declaring the regular 2½% dividends for the first three-quarters of the year, and in deferring action on the dividend for the last quarter. Wages were cut 12½% at the beginning of the year; operating costs are dropping, and, it is thought, must fall to normal in the near future. Among the large items for expenditure during the year were: advance to the West Kootenay Power & Light Co. for power-line, \$698,000; construction of concentrator for Rossland ores, which temporarily is being used for Sullivan ore, \$260,661; enlargement of copper refinery, \$208,912; construction of copper-rod mill, \$127,440; three Dwight-Lloyd sinterers, \$158,760; advance to Sunloch Mines, Ltd., for development, \$72,963; and advance to Coast Copper Co. for development, \$130,704.

Victoria.—Among the recent mining company incorporations are the following: Independent Sand & Gravel Co., Ltd., \$100,000, Vancouver; East Kootenay Prospectors' Development Co., Ltd., \$10,000, Cranbrook; and Sheep Creek Consolidated Mines, Ltd., \$1,000,000, Vancouver. Dominion Engineering Works, \$10,000,000, Montreal, has been incorporated as an extra-Provincial company. The British Columbia members of the Dominion parliament are endeavoring to obtain (1) a specific duty of 1½¢ per pound on copper rods, wire bars, scrap copper, scrap brass, scrap zinc, scrap nickel, and silver and zinc sheets, and (2) an increase of 20% ad valorem on copper, brass, bronze, nickel, and silver sheets, and on copper and brass rods. This without doubt would be a great boon to the Consolidated M. & S. Co., but whether under existing conditions it would help the mining industry as a whole is exceedingly doubtful. At the present time the Consolidated company is buying no custom ore or concentrate, consequently, unless some provision were made whereby metals from Canadian ores refined in the United States could be returned to Canada free of duty, it is difficult to see how the tariff would benefit anyone but the Consolidated company.

The Minister of Lands has announced that a contract has been let to Lynch brothers, of Seattle, for the sinking of a 2000-ft. bore-hole near the south fork of the Red river, about 20 miles north-west of Hudson Hope, in the Peace River district, for the purpose of further exploring the oil

possibilities of that district. John A. Dresser, of Montreal, made a reconnaissance survey for the Government last summer. Work will be started as soon as the drilling outfit can be erected.

MEXICO

Chihuahua.—New York capitalists have taken over a group of silver mines from Manuel Raynol. The properties are known as the Cadamena mines, in the western part of the State of Chihuahua. It is reported that a reduction plant will shortly be erected.—The Dolores Mining Co. is constructing a power plant near the mines. The plant is to develop about 2000 hp., for supply to its mills and other



Silver-Cobalt-Calcite Veins in a Silver Mine at Cobalt, Ontario

plants within a radius of 40 miles.—El Paso capitalists are preparing to develop zinc mines in the vicinity of Miñaca, west of this city.

Monterrey.—Mining operations in the State of Oaxaca are being resumed. Among the recent arrivals at the Taviche camp are John M. Cromwell and L. C. Dennis of Tacoma, Washington, who are preparing to re-open their silver mines. They plan to install new equipment and machinery.—The American Smelting & Refining Co. is making repairs to its smelter at Chihuahua.—In the San Pedro Piedra Garda district, State of Zacatecas, several old and abandoned workings are to be cleared out and development resumed by Antonio Salinas and associates. The principal mines taken over are in the Santa Irene group. New equipment will be installed.—It is reported that the smelter at Torreon will resume operations soon. There is an accumulation of ore at the plant and shippers are anxious for returns. Whether the plant will make only a short run or will continue operations indefinitely has not yet been determined by the management.

Saltillo.—An extension to the Tlaxcalteca mines in the

San Lorenzo mountains near Matamoros has been taken up by Pablo Nave, mining man of San Pedro. The survey is being made by Jose Garza Aldape, engineer. The directors of the Perilita y Anexas Mining Co. have called an assessment of one peso per share on the second issue of stock.

Nacozari. Although the concentrator at Nacozari, Sonora, owned by the Moctezuma Copper Co., is no longer in operation, construction work on the addition to the mill is going ahead. A new Diesel engine is being installed as an addition to the power house at Nacozari and repair and development work is being continued at the mine at Pilares. Altogether about 600 men have been retained on the payroll of the company since the mill was closed down.

ONTARIO

Cobalt.—The Keeley Silver mine in South Lorrain has re-opened, but the mill will remain idle until the price of silver increases. The National Mining Corporation has suspended diamond-drilling operations on the White Reserve property. Operations have been suspended on the Hudson Bay mines. The Mining Corporation of Canada is employing 30 men on the work of re-modeling its mill, so as to be able to treat 300 tons daily as compared with 200 tons as formerly.

Kirkland Lake.—The rapid expansion of Kirkland Lake is shown by the action of the Northern Ontario Light & Power Co. in providing for a largely increased supply of power. The company can now furnish 4500 hp. Further additions are in prospect; the demand is steadily increasing.

S. C. Thompson, of New York, who has been appointed consulting engineer of the Kirkland Lake Proprietary (1919), is making an examination of the Tough Oakes and Burnside properties. The workings are being unwatered, with a view to starting underground work as soon as possible; milling will probably be resumed by the end of August.

At the Kirkland Lake mine exploration by diamond-drilling from the 900-ft. level will be undertaken, holes being run vertically and laterally to determine the geology at depth. The mill is treating 150 tons per day.

The new mill of the Wright-Hargreaves is ready to begin operations on May 1, when the power will be turned on.

Porcupine.—The Hollinger Consolidated has its final battery of stamps in operation, bringing the mill up to a capacity of about 3200 tons daily. The company has now a force of 1450 men employed, and is operating 82 machines. Underground operations are in progress at the rate of about half a mile per month and an output of about \$10,000,000 is indicated for the current year. A contract for the erection of 150 four-roomed houses for the employees of the company has been let.

The Dome Mines Co. is treating about 1000 tons of ore daily, and will not be able to exceed this figure until some changes and additions are made to the mill. The grade of ore now being handled is much higher than that for which the plant was designed.

This season about 60 students of mining from the University of Toronto and Queens' University, Kingston, will go to the Hollinger mine to do practical work. House accommodation not being available they will live in tents. They will work for standard wages and will receive the same treatment as other employees.

The Tommy Burns gold property has been placed under option, and will be explored by diamond-drilling.

The Ankerite Extension, a short distance south of the Domo Mines, has changed hands.

South Lorrain.—The Keeley mine has been re-opened but, for the present, effort will be concentrated on development work, which is being carried on at the 300-ft. level and below it. Ore already in sight is estimated to contain 500,000 oz. of silver in addition to cobalt. The mill will be put in operation when the market shows improvement.

PERSONAL

The Editor invites members of the profession to send particulars of their work and appointments. The information is interesting to our readers.

E. P. Mathewson and Hjalmar E. Skongar are in Paris.

V. V. Tainton is at the Bunker Hill smelter, near Kellogg.

Frank L. Sizer is examining mines near Georgetown, Colorado.

R. C. Gemmell has returned to Salt Lake City from New York.

Hal J. Sisty, of Grants Pass, Oregon, has gone to Sonora, Mexico.

Charles F. Sturtevant, of Salt Lake City, is examining a mine in Arizona.

George Cramer, of Los Angeles, is at Elkhorn, in Jefferson county, Montana.

George F. Carr has moved from Morenci, Arizona, to Long Beach, California.

R. S. Davis has moved from Parral, Chihuahua, Mexico, to Milton, Pennsylvania.

W. R. Lindsay, superintendent for the Engels Copper Mining Co., is in San Francisco.

J. O. Greenan has returned to Berkeley, California, from the Mayo district, in the Yukon Territory.

Sidney J. Jennings attended the meeting of the San Francisco section of the Institute on April 26.

Charles Butters is expected in New York from Nicaragua, where he stopped on his return from Chile.

W. G. Anderson is now mine superintendent for the Dolores Mines, near Madera, Chihuahua, Mexico.

L. D. Ricketts has been visiting the Inspiration mine, at Miami, Arizona. He will be in New York shortly.

A. V. Udell, of San Francisco, is visiting the principal zinc-smelting districts. He is now at Salt Lake City.

H. L. Williams, recently of Salt Lake City, is now with the New Jersey Zinc Co., at 160 Front street, New York City.

S. J. Lewis was at San Antonio, Texas, last week. He is expected here shortly on his way from Mexico to New York.

George W. Lloyd and Charles J. Worden have returned to Quincy, California, and have re-opened their offices at that place.

A. C. Overpeck has just returned to Tucson, Arizona, from Nacozari, Sonora, Mexico, where he has been for three months.

T. G. Valentine Blakey, of Roeburne, Western Australia, is visiting Tonopah and Goldfield on his way back from London to Australia.

H. L. Huston is occupying offices jointly with R. P. McLaughlin in the American National Bank Bldg., 485 California street, San Francisco.

D. C. Jackling left New York on April 28 for San Francisco. While on his way West, he visited the Mesabi Iron, Butte & Superior, and Utah Copper properties.

Frederick B. Hyder has returned to San Francisco from Washington, where he served for a year and a half as valuation engineer for the Bureau of Internal Revenue.

C. W. Plumb, for the past year geologist at the Tintic properties of the U. S. Mining Co., has accepted the appointment of manager of the Crater mine, at Winslow, Arizona.

Samuel S. Arentz, Representative in Congress from Nevada, is the only mining engineer in the national legislature. He graduated from the South Dakota School of Mines in 1904.

K. Baumgarten has been appointed mining engineer to the U. S. Bureau of Mines, attached to the Mississippi Valley Station at St. Louis, Missouri. During the past year and a half he has served in the capacity of examiner on the staff of the War Minerals Relief Commission.

THE METAL MARKET



METAL PRICES

San Francisco, May 3

Aluminum-dust, cents per pound.....	75
Antimony, cents per pound.....	7.50
Copper, electrolytic, cents per pound.....	13
Lead, pig, cents per pound.....	4.75—5.75
Platinum, pure, per ounce.....	\$75
Platinum, 10% iridium, per ounce.....	\$105
Quicksilver, per flask of 75 lb.....	\$50
Spelter, cents per pound.....	7.50
Zinc-dust, cents per pound.....	12.50—15.00

EASTERN METAL MARKET

(By wire from New York)

May 2.—Copper is quiet and steady. Lead is quiet and higher. Zinc is active and strong

SILVER

Below are given official or ticker quotations for silver in the open market as distinguished from the fixed price obtainable for metal produced, smelted, and refined exclusively within the United States. Under the terms of the Pittman Act such silver will be purchased by the United States Mint at \$1 per ounce, subject to certain small charges which vary slightly but amount to approximately three-eighths of one cent. The equivalent of dollar silver (1000 fine) in British currency is 46.65 pence per ounce (925 fine), calculated at the normal rate of exchange.

		New York	London	Average week ending		Pence
Date		cents	pence		Cents	
Apr.	26.....	60.37	34.62	Mch.	21.....	56.69 33.00
"	27.....	60.25	34.62	"	28.....	57.69 33.45
"	28.....	60.62	34.75	Apr.	4.....	56.92 32.98
"	29.....	60.62	34.62	"	11.....	58.00 33.54
"	30.....	60.87	34.75	"	18.....	60.18 34.83
May	1 Sunday			"	25.....	60.22 34.77
"	2.....	61.37	34.87	May	2.....	60.68 34.70
Monthly averages						
		1919	1920		1919	1920 1921
Jan.	.....	141.12	132.77	65.95	July	..... 106.36 92.04
Feb.	.....	101.12	131.27	59.55	Aug.	..... 111.35 96.23
Mch.	.....	101.12	125.70	56.08	Sept.	..... 113.92 93.66
Apr.	.....	101.12	119.56	59.33	Oct.	..... 119.10 83.42
May	.....	107.23	102.69	.....	Nov.	..... 127.57 77.73
June	.....	110.50	90.84	.....	Dec.	..... 131.92 64.78

COPPER

Prices of electrolytic, in cents per pound.

Date	Average week ending	Cents	Pence
Apr. 26.....	12.37	11.87	
" 27.....	12.37	12.15	
" 28.....	12.37	12.68	
" 29.....	12.37	12.50	
" 30.....	12.37	12.50	
May 1 Sunday.....	12.37	12.50	
" 2.....	12.37	12.37	
Monthly averages			
Jan.	1919 20.43	1920 19.25	1921 12.94
Feb.	17.34	19.05	12.84
Mch.	15.05	18.49	12.20
Apr.	15.23	19.23	12.50
May	15.91	19.05	....
June	17.53	19.00	....

LEAD

Lead is quoted in cents per pound, New York delivery.

Date	Average week ending	Cents	Pence
Apr. 26.....	4.35	4.00	
" 27.....	4.35	4.00	
" 28.....	4.50	4.39	
" 29.....	4.50	4.25	
" 30.....	4.50	4.30	
May 1 Sunday.....	4.50	4.25	
" 2.....	4.50	4.45	
Monthly averages			
Jan.	1919 5.60	1920 8.65	1921 4.96
Feb.	5.13	8.88	4.54
Mch.	5.24	9.22	4.06
Apr.	5.05	8.76	4.32
May	5.04	8.55	....
June	5.32	8.43	....

TIN

Prices in New York, in cents per pound.

Date	Average week ending	Cents	Pence
Apr. 26.....	4.35	4.00	
" 27.....	4.35	4.00	
" 28.....	4.50	4.39	
" 29.....	4.50	4.25	
" 30.....	4.50	4.30	
May 1 Sunday.....	4.50	4.25	
" 2.....	4.50	4.45	
Monthly averages			
Jan.	1919 71.50	1920 62.74	1921 35.94
Feb.	72.44	59.87	32.16
Mch.	72.50	61.92	28.87
Apr.	72.50	62.17	....
May	72.50	54.99	....
June	71.83	48.33	....

ZINC

Zinc is quoted as spelter, standard Western brands, New York delivery, in cents per pound.

Date	Average week ending	Cents	Pence
Apr. 26.....	5.45	5.25	
" 27.....	5.50	5.20	
" 28.....	5.50	5.15	
" 29.....	5.50	5.15	
" 30.....	5.50	5.14	
May 1 Sunday.....	5.50	5.29	
" 2.....	5.50	5.49	
Monthly averages			
Jan.	1919 7.44	1920 9.56	1921 5.86
Feb.	6.71	9.15	5.34
Mch.	6.53	8.93	5.19
Apr.	6.49	8.76	5.33
May	6.43	8.07	....
June	6.91	7.92	....

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, according to quantity. Prices, in dollars per flask of 75 pounds.

Date	Average week ending	Dollars	Pence
Apr. 5.....	45.00	45.00	
" 12.....	45.00	50.00	
Apr. 19.....	45.00	50.00	
" 26.....	50.00	50.00	
May 3.....	50.00	50.00	
Monthly averages			
Jan.	1919 103.75	1920 89.00	1921 50.00
Feb.	90.00	81.00	48.75
Mch.	72.80	87.00	45.88
Apr.	73.12	100.00	46.00
May	84.80	87.00	....
June	94.40	85.00	....

IRON AND STEEL

The probability of a wage reduction is overshadowing the steel industry, according to the 'Annalist'. It is becoming increasingly clear, that at current prices, many of the independent manufacturers cannot make any profit, but it is also true that the independents cannot make further reduction in wages until some action along this line has been taken by the United States Steel Corporation. Having already announced a cut in prices, it is anticipated that before July 1, at the latest, the largest producer will have cut down its payroll substantially.

It was stated a few days ago by a manufacturer that labor now represented 90% of the cost of the finished steel. This is the highest point that has ever been touched, and it is plain that if the Stabilization Board prices were as represented—the lowest at which the steel manufacturers could operate—wages must be reduced before there can be any further cut in steel products.

Some new business developed during the past week, but it went largely to the independents for several reasons, the main one being that some of the independent quotations were under those of the Steel Corporation, as represented in the new price schedule. This business has been held up awaiting the Steel Corporation price cut, and when it was seen that the independent level had not been touched, there was a placing of orders.

It is probable, however, that there will be little underselling of the Steel Corporation by the independents. For some time the new price schedule of the Steel Corporation may be considered as representing a fair degree of stability in the market, and hence may call out some orders.

It has been hinted from time to time that the cut in structural material would invigorate building. This would be expected were it not for the fact that structural steel is still well above what builders consider as a reasonable price, and it is likely that building on any extensive scale will await further reductions in steel prices. Ultimately it seems certain that they must come.

The United States Steel Corporation reports a surplus for the common stock for the quarter ended March 31, 1921, of \$9,170,685, equal to \$1.80 per share as against \$4.10 per share for the December quarter and \$4.76 for the September quarter.

As a result of the recent appreciation in the price of zinc one of the larger companies, operating several mills in the Joplin district, and who reported recently their intention of closing indefinitely, have decided to continue operations. This decision will mean that 450 men will be retained on the payroll.

MONEY AND EXCHANGE

Foreign quotations on May 3 are as follows:

Sterling, dollars:	Cable	3.99 1/4
	Demand	3.98 1/4
Francs, cents:	Cable	8.02 1/2
	Demand	8.01 1/4
Lire, cents:	Demand	4.90 1/4
Marks, cents		1.58

Eastern Metal Market

New York, April 27.

The tone of practically all the markets is firm and steady, with prices advancing in several cases.

Buying of copper is fair for both foreign and domestic account. Prices of one or two sellers have eased.

Quietness prevails in the tin market, but quotations are higher.

Lead is in fair demand, but not in great supply; prices are higher.

Zinc is decidedly stronger on good buying by galvanizers.

IRON AND STEEL

Reports from steel-trade centres indicate an improvement in sentiment, with a slight betterment in demand, represented by the belated appearance of spring business looked for in vain last month, says 'The Iron Age'. Operations are little changed, apart from some recovery from a low dip by the Steel Corporation last week. The average for the industry is somewhat under 40%.

Finished-steel prices are generally maintained at the figures announced two weeks ago, the few concessions reported being traceable to quotations made before the advance. A price of 2c. on plants was made by one of the smaller mills.

Stocks of pig-iron in Japan, if purchasers were available, could now be delivered on the Pacific Coast at about \$31.50 per ton, or fully \$6 per ton below what is asked for Alabama iron.

COPPER

There are some sellers who are evidently anxious or compelled to exchange copper for gold; this has resulted in a temporary softening of the market to 12.62½c., delivered, for electrolytic copper for early delivery, as against 12.75c. a week ago. The New York price is, therefore, 12.37½c. Future positions, such as June, command 12.87½ to 13c., delivered. Japan continues a factor, inquiries being reported as 2000 net tons in addition to the 1500 tons or so reported purchased a week ago. It is stated that sales have been made as a result of these inquiries at 12.87½c., New York, for electrolytic, with some at 12.75c., and that a large part of this metal is destined for China for coinage purposes. The Western Union Telegraph Co., through wire-makers acting for this company, is reported to have purchased 5,000,000 to 10,000,000 lb. Other domestic buying is light, but inquiry is good. European demand is held up pending the reparation settlement. Lake copper is quiet and nominal at 13 to 13.25c., delivered.

TIN

The market is without feature of any consequence. Fundamental conditions remain the same as during the past few weeks, which means few sellers and few buyers. There has been no really active day during the past week, the market having been generally quiet. In most cases buyers have made offerings which have been ½ to ¼c. under the asking price of sellers; there has been no disposition on either side to make any concession, which has resulted in no anxiety to buy or sell on an actual deadlock. The quotations have advanced during the week, spot Straits tin being quoted yesterday at 32c., New York, as against 31c. a week ago. In London also an advance has taken place of about £5 per ton, spot standard having been quoted yesterday at £170 15s. per ton and future standard at £176 5s. The higher market abroad is due in part to the advance in the pound sterling and to some light buying in this market late last week and cabled over. Arrivals thus far this month have been very light, 655 tons only, with the quantity afloat reported as 1550 tons.

LEAD

This market continues strong, production and consumption not more than balancing each other. Most of the business is evidently being taken by the leading interest at 4.25c., New York and St. Louis, which continues its quotation. An advance in this is looked for from some quarters. Independent sellers are asking 4.50c., New York, and 4.30 to 4.35c., St. Louis, but are booking few orders. Buying is not heavy, but the market is holding firm and steady. If any change is made in the tariff it is considered that an advance will be recorded over the present 25% ad valorem duty.

Late yesterday the American Smelting & Refining Co. advanced its quotations to 4.35c., New York and St. Louis, which now becomes the market.

ZINC

A decided improvement is manifest in this market. Prime Western zinc, which for many weeks has hung around 4.60c., St. Louis, is now up to 4.95c. and strong with sales at this level and with an asking price of 5c. in some cases. The reason is a pronounced increase in volume of inquiry from galvanizers, heavier than in many months. This has resulted in buying, and in stiffening of values. Some sellers are not anxious to meet the market and are holding off, which is another cause of strength. An increase in the duty is also expected if any change is made. We quote the market for prime Western at 4.95c., St. Louis, or 5.45c., New York, for early delivery. Brass special has sold at 5.17½c.

ANTIMONY

Conditions are reported as firmer in the Orient. Asking prices for wholesale lots for early delivery are 5.25c., New York, duty paid.

ALUMINUM

Demand is very light and the market is quiet. Virgin metal, 98 to 99% pure, is quoted in wholesale lots for early delivery at 28c. f.o.b. plant, by the leading maker; foreign brands of the same purity are quoted by other sellers at 23 to 23.50c., New York.

ORES

Tungsten: Increasing interest by buyers is reported; the tone of the market has improved. Buyers' views are not entirely in harmony with those of sellers, who are inclined to await developments as to the tariff matter. The quotation in Chinese ore is \$3.25 per unit, with Bolivian ore at \$3.50 to \$3.75. Ferro-tungsten is quoted at 58c. per pound of contained tungsten in lump form, guaranteed as to quality.

Molybdenum: The market is inactive with quotations nominally unchanged at 55 to 60c. per pound of MoS₂ in regular concentrates.

Manganese: There is no demand, and quotations for foreign high-grade ore are nominal at 25 to 30c. per unit, seaboard. Importations continue very heavy, those in March having been 69,710 gross tons, bringing the total for the nine months ended with March to 563,678 tons, as compared with 151,098 tons for the same nine months a year ago.

Manganese-Iron Alloys: Demand for ferro-manganese and spiegeleisen is confined to carload and smaller lots which have been sold at the prevailing quotations of \$90, delivered, for American ferro-manganese, and \$32 to \$36, furnace, for spiegeleisen. British ferro-manganese is not a factor now at \$100, seaboard.

Ferro-Silicon: The 50% grade is now openly quoted and obtainable from first hands at \$80 per ton, delivered, as a result of competition among producers for the May order of 200 tons, which probably went at the low bid of \$82.50.

Current Prices of Commodities

The figures given on this page represent the regular current price, at the time of our going to press, to industrial buyers of standard commodities in small wholesale lots on San Francisco Bay. They should not be construed as being quotations nor as being either the lowest or the highest price; they are given rather as a guide by which to follow the trend of the market or to estimate the approximate cost of materials and supplies.

CHEMICALS AND ASSAYERS' SUPPLIES

Acid, sulphuric, com'l 66°, in drums, per 100 lb.	1.50 to 2.00
" " " " " carboys " "	2.60 to 3.10
" " " C. P., 9 lb. bottles, in barrels, per pound.	0.27
" " " " " bulk, in carboys, per pound.	0.22
" " " " " muriatic, com'l, in carboys, per 100 lb.	2.75 to 3.25
" " " " " C. P., 6-lb. bottle, in barrels, per pound.	0.32
" " " " " " " bulk, in carboys, per pound.	0.25
" " " " " nitric, com'l, in carboys, per 100 lb.	9.00 to 9.50
" " " " " C. P., 7-lb. bottles, in barrels, per pound.	0.39
" " " " " " " bulk, in carboys, per pound.	0.32
Argols, ground, in barrels, per pound.	0.15
Borax, cryst. and conc., bags, per 100 lb.	6.00 to 6.90
" " powdered, in barrels " "	6.50 to 7.35
" " glass, ground, 30 mesh, cases, tin lined, per 100 lb.	21.00
Bone ash, 60 to 80 mesh, in barrels, per 100 lb.	8.50
Bromine, 1-lb. bottle, per pound, Merck.	2.00
Cyanide, sodium, 96 to 98%, 100-lb. drums, per pound.	0.31
Lead acetate, brown, broken casks, per 100 lb.	18.50
" " " " " white " " "	19.00
" " " " " crystals, per pound.	0.20
" " " " " C. P., test., granulated, per 100 lb.	17.50
" " " " " sheet per 100 lb.	14.50
Litharge, C. P., silver-free, per 100 lb.	15.50
" " " " " com'l, per 100 lb.	12.50
Manganese oxide, bulk, imported in barrels, per ton.	90.00
Manganese di-oxide, bulk, Caucasian (85% MnO ₂ - ¼ % Fe), in casks, per ton	140.00
Potassium nitrate, double ref'd., small cryst., in barrels, per pound	0.18 ½
" " " " " " " granular " " "	0.18 ½
" " " " " " " powdered " " "	0.19
" " " " " carbonate, calcined, per 100 lb.	0.25
" " " " " permanganate, in drums, per pound.	0.70
Silica, powdered, in bags, per pound.	0.03
Soda, carbonate of (ash), in barrels, per 100 lb.	3.50
" " bicarbonate of " " "	4.00
" " caustic, ground, 98% " " "	6.50
" " " " " solid " " "	5.00

ELECTRICAL SUPPLIES

Armored copper cable, size 8, BXL 3, lead and armor, 100-ft. lots, per 1000 ft.	700.00
Armored copper cable, size 8, BX 3, armor, 100-ft. lots, per 1000 ft.	393.00
Conduit, galvanized iron, ¾ in., per 100 ft.	12.85
" " " " " 2-in., " "	41.30
Copper wire, size 0, bare, 200 to 1000-lb. lots, per 100 lb.	19.45
" " " " " 10, triple-braid, weather-proof, coil lots, per 100 lb.	23.50
" " " " " 14, single-braid, rubber-covered " per 1000 lb.	8.55
Insulators, glass for telephone, No. 9 pony, per 1000.	86.50
" " " " " power, No. 14, per 1000.	103.00
" " " " " porcelain, 6600 v., No. 44, per 100.	21.50
Porcelain knobs, No. 5 ½, 10d. "nailit", per 1000.	34.25
" " " " " " " solid, per 1000.	20.00
" " " " " " " 3 ½ " " "	64.50
" " " " " tubes, 5/16 by 3-in. " " "	11.65
" " " " " " " ½ " 6-in. " " "	42.15
Sockets, weather proof, molded, No. 60,666, per 100.	31.20
Telephone wire, iron, size 12, half-mile lots, per 100 lb.	11.25

EXPLOSIVES

Blasting-caps, No. 6, in lots of 5000, per 1000.	18.80
" " " " " electric, 6-ft., No. 6, in lots of 1000, per box of 100.	9.30
Blasting-powder, "B" soda, in 100-kg lots, per keg of 25 lb.	2.20
Dynamite, nitro-glycerine, 40%, in ton lots, per 100 lb.	20.50
" " " " " gelatine " " "	21.50
" " " " " ammonia " " "	19.50
Fuse, common, in case lots, per 1000 ft.	8.50
" " " " " waterproof, triple tape, in case lots, per 1000 ft.	10.54

FUELS

Coal, Utah steam, \$4 at mine, plus \$7.50 freight to California terminal points, in carload lots, per ton.	11.50
Coal, blacksmith's, in carload lots, per ton.	24.00
" " " " " in small lots, per ton.	27.00
Coke, in carload lots, per ton.	26.00
Fuel oil, per barrel.	2.00
Diesel oil, per gallon.	0.07
Distillate " " "	0.16 ½
Gasoline " " "	0.26 ½

HARDWARE

Anti-friction metal, per pound.	0.24
Babbitt, genuine " "	0.54
Brass sheets, half-hard and soft, per pound.	0.30
Drill-steel, hollow, first grade, in ton lots, per pound.	0.15
" " " " " solid " " "	0.11

Fish-plate bolts, ¾ by 2-in., per 100 lb.	10.40
Nails and spikes (20d to 60d base), per keg.	5.25
Nuts, hot pressed, hexagonal, per 100 lb.	11.25
" " cold punched " " "	13.20
Picks, mining, 5-lb., per dozen.	13.25
Shovels, carbon steel, No. 2, long handles, per dozen.	18.00
Track spikes, per 100 lb.	6.50

HEAVY STEEL AND PIPE

Bar steel, soft, per 100 lb.	4.50
Rails, steel, 8 to 25-lb., per 100 lb.	5.00
Reinforcing-steel, per 100 lb.	5.00
Sheets, corrugated, galvanized iron, 26-gauge, per 100 lb.	8.00
" " flat " " " " "	7.90
" " flat, black iron, " " " " "	7.00
Structural T's, channels, angles, and beams " " "	4.35
A deduction of 15c. per 100 lb. is made on the above when purchased in carload lots.	
Bars, steel, square, cold-rolled, per 100 lb.	7.50
Pipe, wrought-iron, black, standard, 1 ½-in., per 100 ft.	14.00
" " " " " galvanized " " "	17.25
" " " " " black " " 4-in. " "	61.25
" " " " " extra strong " " "	116.75
Shafting, cold-rolled (2 ½ to 3-in. base) " " "	6.25

HOISTING-ROPE

Discounts for delivery from Pacific Coast stocks are: cast-steel, 17 ½ %; extra strong cast-steel, 25 %; plow-steel, 30 %; blue-centre steel, 15 %. The following illustrations indicate the net price for each kind of rope, in standard, 6-strand, 19-wire, 1-in. rope.	
Blue-centre rope, per foot.	0.42 ½
Cast-steel rope, per foot.	0.25 ½
" " " " " extra strong, per foot.	0.28
Plow-steel rope, per foot.	0.30

LUMBER

The figures given are subject to variation, depending upon the size and length. A charge for cartage is also to be added. Prices are furnished by Van Arsdale, Harris Co.	
Fir, No. 2 clear and better, 1 to 2 in. thick, up to 16 in. wide, per thousand feet (M)	90.00
Fir, common, base price, per M.	30.00
Fir, common, 6 by 6-in. up to 12 by 12-in., per M.	36.00
Redwood, rough merchantable, 1 to 4 in. thick, per M.	50.00
" " " " " clear, 1 to 2 in. thick, up to 12 in. wide, per M.	100.00
Spruce, 'B' and better, 1 to 2 in. thick, up to 16 in. wide, per M.	90.00
Sugar-pine, No. 1 and 2 clear, 2 in. thick, up to 16 in. wide, per M.	200.00
White cedar " " " " "	180.00
White pine " " " " "	180.00

MISCELLANEOUS

Air-hose, 1-in., 5-ply, plain, per foot.	0.48 to 0.65
Candles, 'Granite' mining, 6-16-40, 10-case lots, per case.	7.10
Carbide, in 100-lb. cans, per can.	7.75
Cotton waste, best grade, per 100 lb.	16.25
Diamonds for drilling, according to size, per carat.	50.00 to 75.00
Manila rope, grade 1, per pound.	0.20
" " " " " 2 (standard), per pound.	0.19
Packing, flax, per pound.	0.50 to 1.00
" " " " " sheet " " "	0.35 to 1.00
" " " " " steam or water, first grade, per pound.	1.05
Silix lining, crated, per long ton.	35.00
Tube-mill pebbles, Danish, selected (in bags), per long ton.	30.00

PORTLAND CEMENT, LIME, ETC.

Fire-brick, clay, per 1000.	60.70
Fire-clay, in bags, per ton.	18.00
Lime, lump, in barrels, per barrel of 180 lb.	3.25
Portland cement, in bags, per barrel of 380 lb.	4.20
Allowance of 15c. for bags returned in good condition.	
Portland cement in barrels, per barrel of 400 lb.	5.50
A deduction of 50c. per barrel is made on lime and cement when sold in carload lots.	

ORES AND MINERALS

The following prices represent approximately what can be obtained for the products indicated delivered at points on San Francisco Bay. These, of course, vary widely with the grade and purity of the ores. The present stagnant condition of the market makes many of the quotations purely nominal; most of the ores can be purchased at these prices, but it should be understood that it is not easy for the producer to market them at this time. This list is corrected monthly by Atkins, Kroll & Co.	
Antimony ore, approximately free of lead and arsenic, not less than 50% Sb, per c.	60c.
Asbestos (crystalline), according to length of fibre, per ton.	\$20 to \$2500
Barite, white and free of iron (crude), per ton.	5 to 10
Bismuth ore, not less than 20% Bi, per % Bi.	12
Feldspar, crude, lump, free of iron, per ton.	5 to 10
Fluorspar, 85% calcium fluoride, per ton.	15 to 20
Fuller's earth, ground to pass 80-mesh, per ton.	5 to 10
Graphite, crystalline, per pound.	3c. to 7c.
Magnetite, calcined, per ton.	25 to 35
Manganese ore, less than 0.75% Fe; less than 6% SiO ₂ , per ton.	25 to 30
Mica, according to size, cleanness, and cleavage, per pound.	1 to 8
Molybdenite, not less than 85% free of copper, per % MoS ₂ .	8 to 12
Orchre, according to strength, crude, per ton.	8 to 15
Sulphur, 99.5% pure, only trace of As and Se, per ton.	15 to 18
Talc, lump, white, per ton.	7.50 to 10
Tin ore, not less than 60% Sn, per % Sn.	5
Tungsten ore, not less than 65% WO ₃ , per % WO ₃ .	2.75 to 3.00

Company Reports

ALASKA JUNEAU GOLD MINING COMPANY

Report for the year ended December 31, 1920.

Property: Mines and mills at Juneau, Alaska

Operating Official: P. R. Bradley, general superintendent.

Financial:

At least 81% of the gold should be recovered, and the work to accomplish this will be resumed after the company is in better financial condition. As the above grade of rock has been and is being mined and delivered to the mill at a cost of not to exceed 21c. per ton, it is evident that the efforts to increase the daily capacity of the mill, to reduce its operating cost per ton, and to improve its metallurgical efficiency, have been and are all worth while.

PRODUCTION AND EXPENDITURES (OPERATING PERIOD 1914-1920 INCLUSIVE) (CONSTRUCTION AND DEVELOPMENT PERIOD AUG. 1911-DEC. 31, 1920 INCL.)

	942,870 Tons		692,895 Tons		3,327,834 Tons	
	This Year	Per Ton Trammed	Last Year	Per Ton Trammed	Total to Date	Per Ton Trammed
Production—(Gross Recovered Gold, Silver and Lead Values)						
Bullion	\$ 583,134.82	\$.6184	\$ 400,644.29	\$.5782	\$1,820,242.54	\$.5470
Concentrates	208,255.17	.2309	142,069.70	.2051	816,677.18	.2454
	\$ 791,389.99	\$.8393	\$ 542,713.99	\$.7833	\$2,636,919.72	\$.7924
Expenditures						
Mining:						
Prepaid Mining	\$ 9,428.70	\$.0100	\$ 43,693.95	\$.0631	\$ 131,131.98	\$.0394
Stoping	22,701.81	.0241	13,947.12	.0201	424,738.75	.1276
Bulldozing	88,444.67	.0938	74,175.56	.1071	298,400.62	.0897
Tramming	75,142.20	.0797	74,309.89	.1072	312,922.03	.0940
Total	\$ 195,717.38	\$.2076	\$ 206,126.52	\$.2975	\$1,167,193.38	\$.3507
Milling:						
Coarse Crushing	\$ 53,767.86	\$.0570	\$ 50,843.58	\$.0734	\$ 221,897.19	\$.0667
Intermediate Crushing	228,092.35	.2419	192,667.65	.2781	619,818.87	.1863
Fine Crushing	17,594.41	.0187	86,671.07	.1251	566,670.46	.1703
Concentration	23,165.19	.0246	18,904.35	.0273	145,471.68	.0437
Retreatment	22,940.27	.0243	22,113.21	.0319	97,309.01	.0292
Sorting	75,270.87	.0798	17,379.44	.0250	98,937.33	.0297
Total	\$ 420,830.95	\$.4463	\$ 388,579.30	\$.5608	\$1,750,101.54	\$.5259
Other Juneau Operating and Marketing Costs	\$4,320.10	.0094	63,382.88	.0915	401,643.45	.1216
Total Juneau Operating and Marketing Costs	\$ 700,868.43	\$.7433	\$ 658,088.70	\$.9498	\$3,321,941.37	\$.9982
All other Costs and Interest	157,972.63	.1675	138,606.03	.2000	492,007.01	.1478
Total Operating Costs	\$ 858,841.06	\$.9108	\$ 796,694.73	\$1.1498	\$3,813,948.38	\$1.1460
JUNEAU OPERATING PROFIT—Deficit*	\$ 90,521.56	\$.0960	\$ 115,374.71	\$.1665	\$ 685,021.65	\$.2058
NET PROFIT—Deficit*—(1914-1920 Incl.)	\$ 67,451.07	\$.0715	\$ 253,980.74	\$.3665	\$1,177,028.66	\$.3536
Capital and Other Assets: (Aug. 1911 to Dec. 1920, Incl.)						
Property and Plant	\$ 203,415.14	\$.2157	\$ 142,375.61	\$.2055	\$3,449,227.78	\$1.0365
Deferred Charges:						
Preparatory Mining	69,336.17	.0725	41,288.53	.0595	486,236.20	.1461
Mine Development	21,384.47	.0227	66,308.66	.0957	786,818.97	.2364
Total	\$ 294,135.78	\$.3119	\$ 249,972.80	\$.3607	\$4,722,282.95	\$1.4190
Total of All Expenditures	\$1,152,976.84	\$1.2228	\$1,046,667.53	\$1.5105	\$8,536,231.33	\$2.5650
SURPLUS—Deficit*	\$ 361,586.85	\$.3835	\$ 503,953.54	\$.7272	\$5,899,311.61	\$1.7726

*NOTE—Dark face figures indicate deficits.

General: The president of the company, F. W. Bradley, reports as follows: It is expected that during the present month (April) the work of altering and enlarging the mill will have been completed to such an extent as to enable it soon to begin the sorting and milling of 7000 tons of mine rock per day at an operating, sorting, and milling cost not to exceed 28c. per ton, which cost can eventually be reduced to 20c. per ton as originally estimated. The progress so far made in reducing the milling cost has been as follows:

Period	Operating milling (including sorting) cost per ton of rock from mine to mill
Upon completion of the new mill in 1917.....	71.71c.
Year 1918.....	67.62c.
Year 1919.....	56.08c.
Year 1920.....	44.63c.
January, February, and March, 1921.....	40.15c.

After the expected stage of 7000 tons daily capacity has been reached, the work of further increasing milling facilities up to the capacity originally promised will be suspended until after the indebtedness has been substantially reduced. The gold assay value of the rock sent from the mine to the mill has been as follows:

Years	Tons of rock sent from mine to mill	Gold assay value of same per ton	Gold recovered per ton	Recovery %
1893-1913.....	507,254	\$1.71	\$1.39	81.28
1914-1915.....	242,328	1.45	1.04	71.72
1916.....	180,113	0.94	0.64	68.08
1917.....	672,424	0.88	0.64	72.72
1918.....	590,515	0.92	0.73	79.35
1919.....	692,895	1.00	0.72	72.00
1920.....	942,870	1.00	0.78	71.56
Total and averages.....	3,828,399	\$1.11	\$0.83	74.77

Development: 9360 ft., as compared with 10,814 ft. in 1919.

Production: 942,870 tons from mine to mill; 637,321 tons fine ore milled; total value recovered \$791,389.99; assay value of rock from mine to mill, \$1.09.

NIPISSING MINING COMPANY, LTD.

Report for the year ended December 31, 1920.

Property: Mines and mill at Cobalt, Ontario, Canada.

Operating Officials: R. B. Watson, general manager; H. Park, manager; J. J. Denny, mill manager.

Financial: Net income, \$1,256,818.90; net surplus, \$3,817,043.68; dividends paid and payable by Nipissing Mines Co., Ltd., \$1,835,000.

Production: 3,332,302.79 oz. silver.

Reserves: 3,568,000 oz., as compared with 6,354,000 a year ago.

General: The company has purchased an interest in the Croton magnetic-iron mines near Brewster, New York. Exploration at the Texas oil property was discontinued.

FRANKLIN MINING COMPANY

Report for the year ended December 31, 1920.

Property: Mine and mill in Houghton county, Michigan.

Operating Official: E. Henderson, superintendent.

Financial: Receipts, \$138,776.46; expenses, \$285,977.22; deficit, \$147,200.76.

General: No copper was produced during the year; all operations were stopped temporarily in December.

Book Reviews

Science and Life. By Frederick Soddy. E. P. Dutton & Co., New York. For sale by 'Mining and Scientific Press'. Price, \$4.

The author of this collection of essays is one of the foremost authorities on radio-activity; the publication of the book will permit a wider audience to appreciate the results of his researches, both mental and physical. A review of the book, in the ordinary sense, is no easy matter; the subjects have been arranged in haphazard sequence, with the result that repetition was inevitable. The book is marred, and many readers will be disheartened at the outset, by the turgid phraseology adopted in so many places in the first essay, together with a confusion of the abstract with the concrete. The following are examples: "The clock wound up in the beginning to run for a certain time, a universe provided at its creation with a certain store of available energy to dissipate and live by at an ever increasing rate, until it arrived ultimately and inevitably at complete physical stagnation and death, is being displaced by a less arbitrary view as science advances and invades more and more the vast territory still beyond its ken." "The most slowly changing members, on the other hand, are the parent-elements, uranium and thorium, which were well studied by chemists for a century, so feeble is their radio-activity and so slow their rate of disintegration, without a suspicion that, in them, the oft-suspected process of the evolution of the elements was still in progress before their eyes." The improvement in style and clarity in the succeeding addresses is so marked that, as the contents of the book are arranged in chronological order of original presentation, there is evidence of the evolution of a writer, and proof that skill in literary work is acquired, rather than inherited. The author, however, has limited himself, almost entirely, to two forms of punctuation, the comma and the period; the result is that the argument or the conviction is occasionally weakened by what appears to be a lack of appreciation of the elementary aids to lucid exposition. The later essays, however, are so good that it is to be hoped that the author will write a non-technical book on the subject of science and humanity. None of his arguments will lose force by repetition; the classification of the ideas that are scattered throughout the present volume will lead to a better appreciation of his ability to produce what may become a classic.

To a man who has plumbed the depths of a single subject, we learn, the whole world takes on a new meaning. The results of the work of those who labor unselfishly in the fields of knowledge are published freely; they are pooled in the general stock for the benefit of all. Secrecy or individualism of any kind would destroy fertility; individual ownership of knowledge is antagonistic to the spirit of science. In the orgy of lying that accompanied the War, scientific fact was the only proportion of truth that was not cheapened and made nauseating, and which stood so far above personal prejudice and passion as to be unshaken. Is there a single branch of human endeavor, the author asks, that has been left untouched, nay more, that has not been altered to its very foundations, by the progress of science? To spend a feverish life in an attempt to transmute base metal into gold, or to discover the secret of perpetual motion, would be to follow the well-trodden highway that leads nowhere; but to exhibit a transcendent curiosity in an abstruse phenomenon, to win a grain of knowledge for the communism of science, is to stumble upon secrets unawares. The attitude of the man of science is neither that of the technologist nor that of the engineer; he sets forth to discover what there is in the unknown to be discovered, however apparently commonplace and unimportant it may seem. The achievement—the connection between science and life—is this: science can

transfer energy from its inanimate originals and can direct it into living bodies, so that two may live where one only has struggled for an existence.

A platitude is often worth repeating. If you seek fame or riches, we read, enter not upon a scientific career; for they are easier won in politics, in commerce, or in other walks of life. No quicker road to general impoverishment could well be chosen than the treatment habitually accorded to the poor discoverers and inventors, preyed upon by rascals of every description who flourish under the protective majesty of the law and in the grip of a commercialism that deems it the highest wisdom not to pay for anything it can get by other means. If one-tenth of 1% of all the added wealth that scientific men have earned for the community were re-paid, it would suffice them, beyond their wildest dreams of avarice, for laboratories and maintenance. If science is of practical benefit to the millions, and a means of raising the standard of life, it should be a simple business proposition to make sure that the scientific investigator is provided with what is necessary for the pursuit of his work. At present the application of science so lags behind the accomplishment that the creator has ample time to die of starvation; yet this is the science from which all the benefits of modern civilization are derived. Science must no longer be considered as a hobby or part-time occupation of busy teachers, but as a serious business, perhaps the most serious and most momentous of the activities of the State. Given a clear course and that most rare of national qualities, common sense, science can abolish the struggle for existence so far as food and fuel are concerned; but to date the pearls of science have been cast before swine, who in return have given us millionaires and slums, armaments, and the desolation of war. Man, from time immemorial, has boasted and gloried in his physical powers. He was a rude animal, whose turbulent experience has preserved, as a religion, this pride in force as the ultimate arbiter. Science has multiplied man's physical powers ten-thousand-fold, and has increased his capacity both of construction and destruction in like ratio. Writing during the War, the author said that scientific men were concerned with science no longer, but only with the profane application of science to the more efficient destruction of their fellow-men. Our boasted moral superiority over our enemies can only make us deserve the victory, he says; science alone can achieve it for us on the battlefield, and safeguard it subsequently. We may pray for rain; but as the shrewd clergyman once remarked, "What is the good of praying for rain with the wind in the east?" The question, in the author's opinion, is whether science, which in the past century is estimated to have increased the wealth of the world a thousand-fold, will not make each million of debt bear no more heavily than each thousand did upon our ancestors.

What Professor Soddy says about the radio-active elements merits more than ordinary consideration, for his name is associated with some of the most important discoveries that have been made. All heavy elements, we read, if they could be transmuted artificially into lighter ones, would evolve energy on the same scale as uranium, thorium, and radium. Such transmutations are still beyond the power of man to effect, but he would be a bold prophet who would declare for how long this may remain true. Twenty years ago not one single fact was known to science about transmutation. It is now realized that, during the slow changes that occur in the decomposition of the radio-active elements, there is an evolution of energy that is nearly a million times greater than has ever been obtained from a similar weight of matter before. The doctrine of the unchangableness of the chemical elements was no fixed article in the chemist's creed; it was simply the expression of the facts that were ascertainable before the discovery of radio-activity. We now know that both uranium and thorium produce lead as

the final product; and though the lead from thorium is identical, chemically and spectroscopically, with the lead from uranium, yet they are different. Stranger still, the lead that chemists are familiar with as one of the elements is probably a mixture of both kinds. The radio-active minerals are really geologic clocks; in a uranium mineral, for example, each 1% of lead in terms of uranium signifies a lapse of 80,000,000 years; every cubic centimetre of helium per gramme of uranium in a uranium mineral signifies 9,000,000 years. Carboniferous rocks tested by this method appear to have an age of about 350,000,000 years, and the oldest Archean rocks, over 1,500,000,000 years. Gold was the goal of alchemy, we read. The metal is followed in the Periodic Table by mercury, thallium, lead, and bismuth. To get gold from mercury, expel from the atom of mercury one Beta particle, which will make thallium, then one Alpha particle, which will turn the thallium into gold. Unfortunately it is impossible to supplement these recipes with the necessary instructions; but if man ever achieves the transmutation it is certain that the last thing he would want to do would be to turn lead or mercury into gold, for the sake of the gold. The energy that would be liberated would far exceed in importance the value of the gold; rather would it pay to transmute gold into silver or some base metal.

There are occasional references throughout the book to the subject of the relationship of science to religion. The issue cannot be sidetracked; Professor Soddy is to be congratulated on stating the case with incisive logic. The doctrine of organic evolution, he says, cut away some of our most cherished notions. Fallen man, a discredited creature, with eyes ever turned backward into an alleged more glorious past, a feeble and ineffective imitation of bygone days, dressed up by myth and fancy to appear divine, gave place to a truer and more robust conception of a being who had ascended from the animal world—a creature of hope and promise, with eyes ever turned forward to the future, and with reason gradually growing and developing to a point of comprehending the terms on which he stands with universal nature. The scientific man is not deaf to the appeal that the ethics of human conduct, morality, and religion make to mankind in general; it is the ordinary man, and his instructors, the statesman, the headmaster, the poet, the divine, and the artist, who are both blind and deaf to the spirit of science. Their recent attention has been directed to its existence by the fear of annihilation; their interest is mainly in its profanation to the purposes of destruction. Between the spirit of science, which welcomes criticism and knows no finality in its beliefs or authority to impose them, and the spirit of the old creeds, which, in order to survive, must entwine themselves around the immature intelligences of children, there can be nothing in common and no real reconciliation. The world has changed in the last hundred years out of all recognition, not on account of anything contained in the Christian or Mosaic revelations, but on account of the new revelations of science. Though these have come about by a process the reverse of supernatural—by the slow accumulation of knowledge and by honest and unbiased weighing of the evidence—they constitute an essential part of the truth, be our religious convictions what they may. The idea that physical power is one of the attitudes of deity has left behind it a legacy of nothing but calamity. Science has banished the conception of deity from the working of the inanimate world, which behaves in all respects as, and therefore is, a simple machine left to go; the task of controlling it is man's, not God's. Ancient creeds are working an infinitude of harm in the world, and nowhere more so than to the cause of religion. Science, assuredly, has a long road to travel from the stars to the kingdom of heaven. There seems to be the one chasm that cannot be crossed, and which, though the gulf ever narrows, still remains unbridged. As Tennyson has it:

"Flower of the crannied wall,
I pluck you out of the crannies,
I hold you here, root and all, in my hand,
Little flower—but if I could understand
What you are, root and all, and all in all,
I should know what God and man is."

A. W. A.

Financial Engineering. By O. B. Goldman. 267 pp., ill., index. John Wiley & Sons, Inc., New York. For sale by 'Mining and Scientific Press'. Price, \$3.50.

This is a book on valuation, not only for rate-making and sale purposes, but also as a guide in choosing between different designs or between different types of equipment. The first few chapters discuss the principal considerations affecting valuation, including depreciation, appreciation, obsolescence, maintenance, and other factors. Various formulas are derived for use in computation of these factors. Then the author considers the basic costs, and what he calls the 'vestances', usually called the present worths, of various kinds of engineering equipment and supplies. Other chapters discuss the determination of unit costs, of size of system for best financial efficiency, and of type and size of units. The book will be of particular value to the engineer engaged in the valuation of public utilities, but will also be useful to the designing engineer in general.

Mechanical World Year Book for 1921. 328 pp., ill., index. Emmott & Co., Ltd., Manchester, England. Price, 2s. 6d.

While this volume hardly compares with the various American handbooks, still, when the price is considered, it is remarkable how much is given for the money. The principal changes in the 1921 edition are additions to the divisions on tooth gearing, ball and roller bearings, and friction and lubrication, as well as a number of revisions.

Recent Publications

Iron and Associated Industries of Lorraine, the Sarre District, Luxemburg, and Belgium. By Alfred H. Brooks and Morris F. LaCroix. Bull. 703, U. S. Geological Survey, 1920.

Oil Possibilities in and Around Baxter Basin in the Rock Springs Uplift, Sweetwater County, Wyoming. By Alfred R. Schultz. Bull. 702, U. S. Geological Survey, 1920. 107 pp., ill., index, maps.

Character of Coal in the Thomas Bed near Harrison, West Virginia. By Marius R. Campbell. Bull. 716-H, U. S. Geological Survey, 1921. 3 pp. From Contributions to Economic Geology, 1920, Part II.

The Clays and Shales of Virginia West of the Blue Ridge. By H. Ries and R. E. Somers. Bull. No. XX, Virginia Geological Survey, University of Virginia, Charlottesville, Va., 1920. 118 pp., ill., index, map.

Lithologic Subsurface Correlation in the "Bend Series" of North-Central Texas. By Marcus I. Goldman. Prof. Paper 129-A, U. S. Geological Survey, 1921. 22 pp., 1 plate. From Shorter Contributions to General Geology, 1921.

The Weno and Pawpaw Formations of the Texas Comanchean. By W. S. Adkins. **On a New Ammonite Fauna of the Lower Turonian of Mexico.** By Emil Böse. University of Texas Bull. No. 1856, October 5, 1918. University of Texas, Austin, Texas. 249 pp., 20 plates, index.

Coal in the Middle and Eastern Parts of San Juan County, New Mexico. By Clyde M. Bauer and John B. Reeside Jr. Bull. 716-G, U. S. Geological Survey, 1921. 82 pp., ill., plates, maps. From Contributions to Economic Geology, 1920, Part II.

INDUSTRIAL PROGRESS



INFORMATION FURNISHED BY MANUFACTURERS

WILFLEY TABLES

'Wilfley Concentrating Tables' is the title of a valuable bulletin, No. 64, recently issued by the Mine & Smelter Supply Co. The following statistical data may perhaps surprise many—at any rate they are interesting, as indicating the remarkable general favor enjoyed by the tables.

"More than 22,000 Wilfleys have been made and shipped to all parts of the world. The total weight of these tables is about 55,000,000 lb. In their construction there has been used over 4,000,000 ft. of the best grade of redwood lumber and more than 44,000,000 lb. of iron and steel."

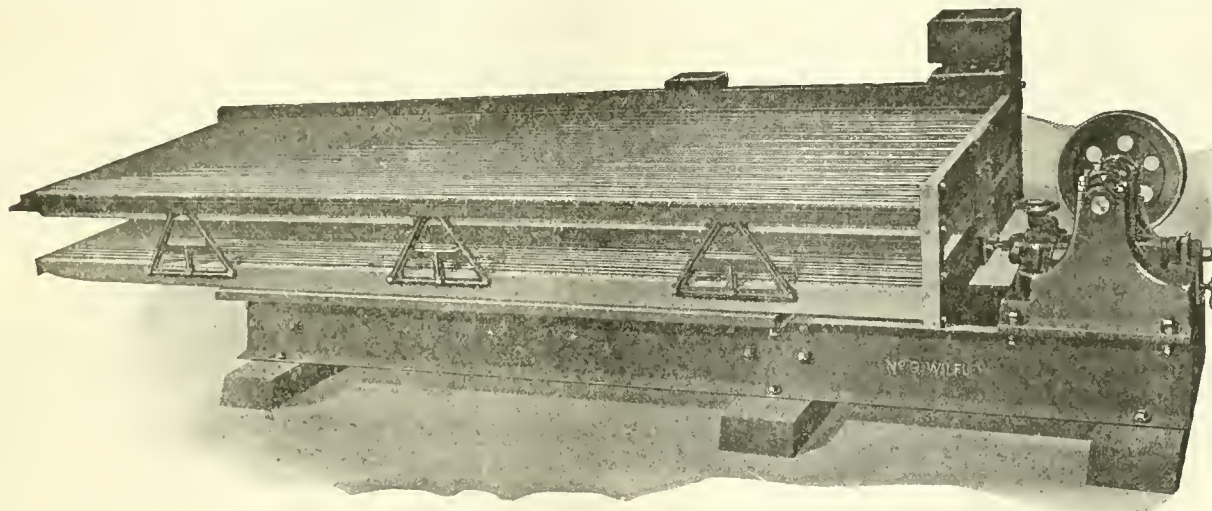
The principles on which the design of Wilfley concen-

trators is based are analyzed and the uses for which they are especially suited are outlined. The various types of tables are then described in a general way. Of the No. 9 concentrator, illustrated herewith, the following comment is made.

Montreal in the Dominion Express building. Alexander C. Barker, vice-president, is in charge of the office. The company is a consolidation of Westinghouse, Church, Kerr & Co., Inc., and Dwight P. Robinson & Co., Inc., and has done extensive construction and engineering work in Canada for the Canadian Pacific Railway, Canadian Salt Co., Canadian Crocker-Wheeler Co., Dominion government, Aetna Explosives Co., Grand Trunk Railway, and others.

HANDLING MATERIALS

In the handling of materials that must be lifted and moved from place to place, cranes and chain-hoists play an im-



The No. 9 Wilfley Concentrator

trators is based are analyzed and the uses for which they are especially suited are outlined. The various types of tables are then described in a general way. Of the No. 9 concentrator, illustrated herewith, the following comment is made.

"The No. 9 Wilfley concentrating table is a double-deck table operated by a heavy pitman and toggle-type head-motion, which is especially designed to stand the increased duty of operating two decks. This table is useful where increased table capacity is desired on limited floor space. Double-deck tables should not be used except in case of necessity and then only for a one-mineral separation, because unless the operator uses care it is difficult to obtain duplicate work from both decks. The upper deck is supported from the lower deck by means of six deck-connecting irons, with a clearance of 10 in. between decks. Each deck has separate feed and water-boxes. A single tilting device, positive in action, controls the side inclination of both decks."

Important features of construction are gone into and information as to the operation is given. The booklet should be a valuable asset to the ore-dressing engineer.

Dwight P. Robinson & Co., Inc., engineers and constructors, of New York, has recently opened branch offices in

portant part. The chief advantage of these machines lie in their great power and self-locking features. Light and compact, for short lifts, they are unsurpassed by any device yet designed. They are made in sizes up to 30-ton capacity.

For the handling of heavy materials and for work involving high lifts, cranes are frequently used, although the number in use is rather small. A common method employed is that of erecting beams with trolleys or runners to which chain-hoists are attached. The proper selection of a chain-hoist involves, according to H. F. Wright, vice-president of the Wright Manufacturing Co., an understanding of principles that are frequently overlooked.

There are three separate and distinct types of chain-hoists on the market, the differential pulley-block, the screw-hoist, and the high-speed hoist. Each of these are made for a particular class of work. The differential pulley-block was the first to be used, and as it costs only one-third as much as its more modern rival, is still found occasionally where considerable lifting is done.

In addition to price, two other factors must be considered when a new hoist is to be purchased: speed, or the number of feet of hand-chain that must be overhauled to raise the load to a given distance; and force, or the pull in pounds required on the hand-chain to raise the weight. As ordinarily

made, the number of feet of hand-chain that must be overhauled to lift a given load is about the same with the pulley-block and high-speed hoist. And as the differential pulley-block is the cheaper hoist, it evidently is to the question of force, or the effort exerted on the hand-chain, to which we must look to establish the superiority of the high-speed hoists.

What are the facts? With a $\frac{1}{2}$ -ton high-speed hoist, a pull of 60 lb. only must be exerted as against a pull of 120 lb. with the differential pulley-block; with the 1-ton high-speed hoist, a pull of 80 lb. only must be exerted as against a pull of 218 lb. with the differential block; and with the 2-ton high-speed hoist, a pull of 120 lb. is exerted as against 306 lb. with the pulley block. Thus, it is evident, the problem reduces to one of labor versus price. From two to three times as much effort must be exerted to lift a load with the differential pulley-block as with the high-speed hoist. Is the difference in price sufficient to warrant the expenditure of this wasted man-power, for this energy is actually wasted, being consumed in overcoming the friction of the machine?

The screw-hoist is of the worm and worm-wheel type and is designed to be used for work where the hoist has to be continually shifted about as in general repair work. It is more efficient than the differential pulley-block but only about 50% as efficient as the high-speed hoist. With this hoist the pull on the hand-chain is cut down at the expense of speed. For example, with a 1-ton screw-hoist 60 ft. of chain must be overhauled to raise the load one foot, while with the high-speed hoist only 30 ft. need be overhauled to do the same thing. With both hoists, however, the force applied is about the same.

COTTON ROPE FOR TRANSMISSION

The various advantages of cotton rope are almost unknown in the country, but its superiority for certain types of service has been recognized for over a half century on the continent where it has been used almost exclusively for power-transmission purposes. In securing the exclusive agency for Kenyon cotton rope in the United States and Canada, the Dodge Sales & Engineering Co., of Mishawaka, Indiana, feel it has made a connection which will enable it to place on the market a power transmission unit on a par with the quality of their other products.

The construction of Kenyon cotton rope is especially interesting; the patent inter-stranding consists of a series of twisting operations, first the yarns, then the threads, and afterward the strands, these being finally locked together by reversing the turn. This results in a trinity of elastic spirals acting in unison and so wedged into each other that they will bend pliantly without undue wear or without disturbing the relationship. Ordinarily, it is claimed that cotton rope will outlast manila rope. While manila rope wears on the outside, the principal wear takes place on the inside, due to the continual sliding of the fibres, one on the other, as the rope is bent around the sheaves. Cotton rope will run successfully over sheaves much smaller than is possible with manila rope. This makes it specially useful in small-sheave high-speed work. In this particular type of work it will deliver a maximum of service with a minimum of wear.

Kenyon cotton rope is being used in this country by a number of industries among which are steel mills, electrical companies, textile manufacturers, and cement manufacturers, and they are all enthusiastic over its successful use.

The Chicago Pneumatic Tool Co., in Bulletin 639, describes features of its BQ-46 hammer-drill. It is adapted for demolition work. It is simple in construction, compact, and its weight is such that it can be handled by one man in practically all kinds of work. It is particularly useful in the demolition of old buildings, concrete walls, foundations,

drilling of anchor-bolt holes, and work of similar nature. It is well adapted for street-railway work in taking up brick, concrete, or asphalt pavement along the rails and between the ties. It is an ideal tool for removing surface pavement in laying conduits for telephone and lighting circuits, and in the construction of gas and water mains. In the steel-mills and glass-plants it is used for removing slag from ladles and slag-pockets, glass from furnaces, etc. It has a useful field in public road and street construction, especially where old surfaces have to be removed. In demolition work of almost any nature it will be found to practically equal the work of ten or twelve men using hand-steel, and in many concrete cases has paid for itself in a few days.

THE USE OF ELECTRIC SHOVELS

Electric shovels are used by the Hydro-Electric Power Commission of Canada in digging the Queenstown-Chippewa power canal around Niagara Falls. There is a difference in elevation between Lake Erie and Lake Ontario of 330 ft. This power plant will operate under a head of 305 ft. The flow of water in the canal, when the plant is operating at full capacity, will be 10,000 ft. per second and the plant will develop 300,000 hp. The length of the canal will be 13 $\frac{1}{2}$ miles. The Welland river is used for 4 $\frac{1}{2}$ miles for this canal, the remaining 9 miles being excavated. The Bucyrus electric shovels used in digging this canal have made some remarkable records during the last year. In one 10-hour shift as high as 4930 cu. yd. of earth was removed by one 300-ton shovel. This is the equivalent of a day's work of 600 men. The shovel making this record, which is of the revolving type, is the largest shovel ever built having a boom of 90 ft. long. There are three shovels of this size and four smaller ones used on this work. All of these shovels are driven by Westinghouse A.C. motors. The electric shovel is making rapid strides in replacing the steam shovel.

RIVET-CUTTING RECORD

What is said to be the record for cutting rivets in the dismembering of steel freight-cars was recently established by an operator who cut out 1038 rivets in 2 hr. and 46 min. Of this number 683 were $\frac{5}{8}$ -in. rivets, 228 were $\frac{3}{4}$ -in., and 127 were $\frac{7}{8}$ -in. rivets. The cutting was done on a standard Erie car under general yard conditions, the operator taking the rivets as they came, working inside, outside, and under the car. The car was one that had been retired from active service and that was in the car-shop for repair, the rivets and plates being covered with heavy scale and rust, thereby rendering the cutting extremely difficult. It is said that the record applies not only to the number of rivets cut in the time required but also to the low consumption of gases used, the job taking only 384 cu. ft. of oxygen and 83 cu. ft. of acetylene. The operator used an Oxweld cutting blowpipe with a rivet cutting nozzle.

PORTABLE MINE-CAR AIR-COMPRESSOR

The Sullivan motor-driven portable air-compressor, class WK-26, mounted on a special truck, is being used to supply air-drills in remote workings, pneumatic tools on steel construction, for paint sprays, and for any work above or below ground in which a little air is required at widely separated points and for relatively brief periods. To operate these machines, it is only necessary to connect the outfit to an electric feed-wire, throw a switch, and the air-power is ready for use. The plant will operate wherever rails can be laid, or where a hard road is provided. The Sullivan WK-26 consists of a single-stage, horizontal air-compressor, operated by gear and pinion from a motor, the two being securely mounted together, with air-receiver and electrical fittings, upon a rigid cast-iron frame, forming the bed of the truck. Details are given in Bulletin 77A, issued by the Sullivan Machinery Co., of Chicago.



T. A. RICKARD, . . . Editor

AEROPLANE transport to and from isolated mining districts may be practicable in some instances, though expensive. We learn that aeroplanes are to go to a spot between Elk Lake and Poreupine for the purpose of bringing out about twenty tons of high-grade asbestos. The details, particularly as regards cost, will be awaited with interest.

CUTTING heated cast-iron with a stream of oxygen has been usually considered as impracticable; the author of a recently published textbook on the subject of oxy-acetylene operations endorses a definite statement to that effect. It is therefore pertinent to emphasize the fact that it can be done and is being done daily. Further, experience and practice leads to a material reduction in the consumption of oxygen and acetylene, the equipment needed is the same as is used for ordinary oxy-acetylene cutting, and pre-heating is often unnecessary.

ACCORDING to Dr. Henry A. E. Chandler, economist of the National Bank of Commerce in New York, the currencies of Europe are unlikely ever again to regain their pre-war values. Even the re-establishment of the normal trade-balances could not bring the exchanges back to par; the radical reduction in the purchasing power of European money would still remain. The trouble is largely due to the continued issuance of large volumes of paper currencies, many of which have no semblance to stability of value. The problem has been complicated by the fact that people have been in the habit of thinking in terms of pre-war parities. Misunderstanding in this respect has led to the purchase of foreign currencies in the hope of a return to pre-war levels.

GOLD continues to accumulate in the vaults of the Federal Reserve banks, but most of us have ceased to chortle at our vast holdings of the money metal; like Midas we have discovered that one can have too much of it, in the sense of a medium of exchange. Nevertheless many of our legislators seem to fear the prospect of our being paid in goods from overseas and appear anxious to build a Chinese wall of tariffs so as to exclude imports. Financiers, however, and economists of the less provincial sort, recognize the fact that it is to our interest not to collect more of the gold in the world but to encourage commerce, meaning the exchange of commodities, with our customers in Europe and elsewhere. The United

States is not an island in the Arctic ocean; it is a populous continent, united by maritime traffic with the continent of Europe on one side and the continent of Asia on the other. Our prosperity is linked with that of others and the welfare of all is dependent upon the barter of the things we make for the things the other fellows make. To collect all the gold and to exclude imports is a policy that will lead to stagnation and poverty all round.

WE refer to the decision in the Oatman case elsewhere. Here we may note the unfortunate use of the word 'locate' in different senses within the same context. The Judge says, correctly, that "Ely Hilty *located* the Grey Eagle claim". He also speaks of the "orebody *located* beneath the surface of the Big Jim claim". Here 'located' means 'situated'; it does not mean that the orebody was made the subject of a 'location' in the legal sense, which is the sense in which he had used 'located' just before. Again, he says that the plaintiff failed to show proof of extra-lateral rights "on the Big Jim vein *located* within the property of the defendant". What does 'located' mean here? Presumably, 'found' or 'discovered'. We have thus three meanings for one word in the same opinion.

NOT every president of a mining company is as honest, or as frank, as Mr. E. P. Earle, of the Nipissing Mines Company, in describing the outlook of the enterprise to the stockholders. In his recent annual report Mr. Earle declares that "the year's exploration and development work was unfortunately not productive of satisfactory results, and in consequence the reserves stand at 3,568,000 ounces as against 6,354,000 ounces a year ago. It is evident that unless future prospecting develops additional ores and the price of silver improves, the earnings of your operating company will continue comparatively unsatisfactory". If considerable bodies of new ore are found, the stockholders will be pleasantly surprised; if nothing important materializes, they will have no cause for being disgruntled. Nipissing has paid \$22,000,000 in dividends, approximately four times its capitalization, so that even if it has passed the crest it will be remembered as one of the world's great mining enterprises.

SECRETARY FALL of the Interior Department has reversed the ruling of his predecessor, Mr. John Barton Payne, with respect to the granting of permits for

prospecting for oil or gas when application for a permit has been filed, but not actually granted, prior to the discovery of oil or gas in a particular geological structure and prior to the designation of such structure by the Government as oilbearing. According to the new ruling, such applications and the permits subsequently issued will be valid. Technical points aside, this appears to be equitable; the fact that a classification or designation by the Land Office intervenes between the date of the application and the date when the permit is issued, should not alter the legal status of the applicant. Another opinion removes the limitations as to the number of permits allowed to the same individual or company. The previous ruling restricted each applicant to one permit on a structure and three within a given State. This has been revoked.

THE proprietor of the Athenaeum Press, of London, has shown an unusual willingness to meet the present social situation in England. He maintains that the workmen can manage; the manager only partly earns his income, he says. On returning from a holiday from Brighton he told his employees that they were still to consider him at a distance, except in case of difficulty or urgency. During the ten days that elapsed afterward he was not consulted, neither were complaints received from the firm's customers. The weekly wage-earners carried on the work satisfactorily; but whether this scheme would be practicable in a more complex organization than a printing establishment is doubtful. However, the action is indicative of a desire on the part of a group among the controlling interests to concede that the standard of intelligence of the wage-earning classes in England is high enough or may be raised high enough by the acquisition of authority and responsibility; it indicates an idea of social democracy that should be welcomed if it can be carried out in good faith. There's the rub.

A MOVEMENT is said to be on foot in Washington to extend for an additional six months the time for doing assessment work on mining claims for 1920, that is, until January 1, 1922, and to relieve claim-owners entirely from any work for 1921. We believe this to be unwise. The intent of the assessment law is primarily to prevent speculators from holding claims with no intention whatever of developing them; such men wait for bona-fide prospectors or miners to uncover ore in neighboring claims and then profit by their work. Compulsory annual assessment work is a protection to the legitimate claim-owner. During the period of the War the national necessity for devoting every energy to actual production was a valid reason for suspending the requirements for assessment work. Men and time could not be spared for work that did not bring immediate and certain results. That argument no longer holds; on the other hand, many men are idle and need employment. The miner who owns his own claim can afford to do the work himself; speaking generally, the only people who will benefit by the proposed suspension are the very ones against whom the law

was originally aimed. As we have suggested before, one excellent amendment to the present statute would change permanently the final date for performing the annual assessment work from January 1 to July 1. Congressional action taken some months ago extended for six months, or until July 1, 1921, the final date for the completion of the work for 1920; accordingly, it would be convenient to make the suggested change at this time.

THE belated resignation of Mr. James Stillman as president of the City National Bank is a sign of healthy public opinion, for it would have been extremely unfortunate if a man directly involved in such a miserable scandal had remained at the head of such an important institution. We regret to note that the announcement of the resignation of Judge Landis has been denied, for it is manifest that the baseball magnate, at a time when the professional game is played in so palpably corrupt a manner, ought to be off the bench. Speaking of such matters, we marvel at the lack of humor, not to mention honor, shown by Mr. Schwab's friends in praising him for declining to accept a \$100,000,000 bribe from the Germans and a later \$150,000,000 bribe from the British to cross and double-cross those with whom he had entered into a contract of national and patriotic importance. We do not believe for a moment that Mr. Schwab did or would succumb to such a coarse form of corruption, and it is pathetic that his friends should seem to think it something noble to have refused to do such an unspeakably dirty act. They are setting a pitifully low standard before the eyes of our young men by their public acclamation of Mr. Schwab in this connection.

SUN YAT SEN is figuring again in the news from China, this time as head of a liberal government at Canton. In a letter just received from a distinguished mining engineer we are told that Sun Yat Sen was an idealist when he started his campaign as a reformer, but that now he is grasping at power. The five southern Provinces, not long ago united in favor of a republic, are now warring among themselves. Bands of troops ravage the country and hold the villages to ransom. The soldiers become bandits when their pay is withheld and they are told to take their rifles and go home. Different factions fight each other and all authority is at a discount. Nevertheless with characteristic imperturbability most of the people continue to work hard; one village may be looted, but that does not seem to suggest to those in a neighboring village that their turn is coming next. The little wheelbarrows are still trundled on their squeaky way and the natives move to and fro with heavy loads strung on the end of a bamboo placed across the shoulders. Immemorial custom survives the ferment of an hour. Yet, our correspondent says, China is intellectually as well as physically in the throes of a revolution. Her literati are abandoning the old beliefs. Stunned by the new ideas, they are overwhelmed by pessimism. The absorption of Western thought has been too rapid; Western education was adopted before there was a sufficient supply of teach-

ers; the Chinese are seething with intellectual unrest, of which the political revolution is a minor symptom. Too advanced for the old imperial government, China is not yet ready for a democratic system.

SPEAKING at Washington on April 26, Mr. D. R. Crissinger, the Comptroller of the Currency, said, referring to the operation of the law of supply and demand, that "Scarcity, coupled with the desire to have, should and does fix the price. If things people need to eat, wear, and house them, could be bought with the assurance that the price was governed by the same unfettered law, our economic troubles would soon solve themselves. Unfortunately for us all, the law of supply and demand is in these respects as dead as a New England salted mackerel. Manufacturers, jobbers, wholesalers, retailers, laborers—all are in some sort of a combination to frustrate this fundamental law of economics. Each is out to 'get his' first. These combinations," he said, "have raised the prices of things to the point where there is no relation between the cost of raw materials and cost of production; no relation between cost of production and cost to the consumer; in short, there is no relation between value and selling price." Mr. Crissinger considers that there must be a vital readjustment of wages before we can have permanent reconstruction and industrial readjustment. A correct understanding is needed between those who serve and those who are served.

METALLURGISTS for the Utah Copper Company can find a measure of satisfaction in the annual report for 1920, even though it is not a pleasing document in the eyes of the average stockholder, who concentrates his curiosity on the financial statement. The recovery of copper in the mill at Garfield was 81.38%, as compared with 78.46% during 1919 and only 65.11% during 1918. A writer for the 'Boston News Bureau' says that "the increase in plant efficiency, with a consequent higher recovery, has been a source of much encouragement". This statement might mislead some, especially in respect of the comparison with 1918; the inference is that the increase in extraction of more than 16% is the result of more efficient operation in the mills. As a matter of fact, it is due largely to the shutting-down of the Magna mill shortly after the Armistice in 1918. The Magna plant is the oldest and the largest, from the standpoint of capacity, of the milling plants of the 'porphyry' companies, but its equipment does not include flotation machines. It was the low extraction obtained in the Magna that brought down the average for 1918, although the Arthur plant was doing almost as well as it did in 1919. Aside from the improvement arising from progress in the technique of the flotation process, we venture to say that other factors helped to account for the better record during 1920. A mill can digest efficiently only a fixed amount of ore, and no doubt the reduced tonnage facilitated the attainment of better metallurgical results. Another truth that was forcibly impressed on many mill-superintendents during the War is that few common laborers

can be made into good mill-men; and that to get the maximum extraction an operator in a concentrator must do more than keep the wheels going around. The average young man who works in a mill is an intelligent youth; he is the best type of young American, as is indicated by the large proportion of such employees that went overseas. Without detracting from the credit due the metallurgists in charge of operations, we venture to suggest that one important reason for the improved milling results, not only at Garfield but elsewhere, is the return of the young employees who served in the army.

JAPAN, according to authoritative reports, is purchasing American copper; recent sales of 1500 tons are the first transactions of appreciable size for more than a year. This is hard to explain in view of the fact that the Japanese are credited with holding stocks aggregating 60 million pounds. Under existing conditions there is no profit for most Japanese mines when the market price at Osaka is below 15 cents; the import duty is 0.6 cent per pound, and the freight from the United States is about 0.8 cent. It is obvious that American producers will be glad to sell from their large stocks at a price that will discourage competitive production in Japan. Domestic copper for fourth-quarter delivery can be contracted for in New York at 13½ cents per pound, so that it is clear why the producers in Japan, the second most important copper-mining country in the world, are curtailing still further their already restricted output. At present Japan is making copper at only one-third the average rate of 1917, when the total production was 129 million pounds. Although it seems unreasonable to expect that Japan will be an immediate factor in eating into the billion-pound surplus that hangs over the heads of the American copper producers, the temporary decrease in the world output will assist in hastening the revival of the industry. Further comfort for the copper companies may be found in the statistics of domestic consumption, which indicate a substantial improvement during April.

Another Apex Decision

In this issue we publish an abstract of the opinion handed down by Judge Elmo E. Bollinger of the Superior Court of Mohave county, Arizona, in the case of the Tom Reed Gold Mines v. the United Eastern Company. The point at issue was the ownership under the mining law of the faulted portion of a vein that has its apex in a claim owned by the plaintiff. The question was whether apex rights extended to that portion of the vein that has been thrown by a fault into the ground of a neighbor. In this case the vein has been dislocated twice and thereby broken into three segments, of which the middle one is small; the third, or the one farthest from the apex, constitutes a rich orebody entirely within the side-lines of the neighboring property, where it has been exploited most profitably, so that the adjudication of ownership to this part of the vein involves a large sum of money. The Tom Reed company, under its apex

rights, laid claim to all of the faulted vein because it could establish the geologic identity of the three segments. The Court says that not only identity but continuity also must be established, and that continuity does not exist where a vein is dislocated vertically 130 feet and horizontally several thousand feet by a "non-mineralized" fault. Moreover, the Court says that if the fault were mineralized, and became thereby a vein, it is not to be supposed that the apex law would give extra-lateral right to "a blanket vein or one that extends laterally", or to "a vein on its upward course", because the statute that grants the right says "downward course" or "course downward". As to whether it be 'upward' or 'downward' depends, of course, upon the point of discovery; if a vein is cut in an adit it may extend upward to the surface or downward to the Antipodes; as to whether the enrichment with metal that makes it valuable to man was caused by solutions moving 'downward', 'upward', or 'laterally' is a point of nice geologic investigation, far beyond the ability of any trial judge to determine. There appears to have been general agreement as to the local geology and more particularly as to the structural relations of the parts of the vein and, in turn, of these parts to the system of faulting; but the judge holds that if the decision were to be based upon the theory of geologists no mining location in the Oatman district would be valid, so he waves aside the scientific testimony and asserts his intention to settle the case "from a practical standpoint and adopt the views of the practical miner". Here we may state that this was the first mining suit tried by Judge Bollinger, and in order to prepare himself he had studied not only the mining law but had read books on economic geology. In the end he rejected the geological evidence and fell back on what he calls the practical standpoint. This illustrates anew the absurdity of our entire system of jurisdiction in disputes arising from the interpretation of the apex law. In this case, however, it is fair to say that the absurdity of the performance was not heightened by opposite testimony from the 'experts' or professional mining geologists acting as witnesses for the two litigants. Indeed the interesting fact was brought out in the course of the trial that Mr. H. V. Winchell had made a report on the Big Jim property for the previous owners, who sold to the United Eastern company, before the litigation was anticipated; in his report he had stated that his clients were entitled to the ore-bodies in their claim on the basis of a "sub-fault apex". This, of course, strengthened his position as a witness or advocate in behalf of the defendant. The decision is far-reaching because it sets aside as negligible the 'drag' along a fault or other evidence of continuity between the faulted parts of a vein. The interpretation of the Court's opinion, however, leaves plenty of room for misunderstanding and for dispute, because it is not based on the recognition of scientific facts. "If veins are separated permanently", the Court says, "and cannot be followed as the same vein, and it is necessary to pass through great distances of country-rock in order to connect them, in which distances there are neither mineralized walls nor

seams, such veins must be deemed separate and distinct ones and cannot be identified as one and the same". In short, a non-scientific lawyer tells the geologist that his diagnosis of structure is of no consequence and that his establishment of identity on facts of observation does not enter into the question. This, of course, is absurd. We may ask also how does the Court define a "permanent" separation between veins? What are "great distances of country-rock" and what are "mineralized walls"? Another definition appearing in the opinion is that of a 'fault', which Judge Bollinger says is "merely a vein which is not mineralized"; from which one may infer that he considers a vein to be merely a fault that has been mineralized. What is 'mineralized'? Presumably he means enriched by the deposition of valuable mineral, for faults contain quartz, clay, and other minerals usually of no economic value when found in a metal mine. If the presence of valuable mineral converts a fault into a vein, how will the judge define the value, which, of course, changes from time to time in sympathy with the metal market. Here is an official of the law passing judgment in technical matters concerning which he has no real knowledge; we have the spectacle of an adjudication made by a man ignorant of science and for that reason setting aside geologic facts as irrelevant, although the entire legal theory of the apex law is based upon the recognition of the structural relations of ore deposits.

The Craze for Mere Bigness

We hear so much, in these days, of co-operation, co-ordination, correlation, organization, and amalgamation, that we are tempted to analyze the conditions prevailing. Are we gaining in efficiency as a result of the application of the craze for bigness? Is it invading our universities to the detriment of real education? Mr. Alfred E. Stearns, in speaking recently at Boston, emphasized the national need for men who can think straight, whose minds are trained, who are actuated by high ideals, and who can see the problems ahead. He deplored the tendency of so many of the colleges to depart from the old cultural standards, and from a system of education that provided intimate contact with human nature and ensured analysis of its weakness and its strength. The will-o'-the-wisp of expansion, he said, leads nowhere. What are the advantages to be found in the super-industry, whose one aim is absorption and amalgamation, or the suppression of the competitor? It is obvious that in the small organization there is a personal contact between the members of the staff that inculcates frankness and honesty; in the struggle for existence against the absorptive designs of the great corporations, it must be managed efficiently in order to be able to exist, benefiting as it does from none of the enormous advantages that should accrue from the availability of funds for development and expansion or from the co-operation of large staffs. Apart from this, it is interesting to note to how great an extent many of the large corporations owe financial success to investments and speculations outside

ordinary business, consummated because they are in a favorable position to feel the pulse of, and at the same time to influence, the money market. This is not an evidence of industrial efficiency. The case of the individual is a parallel one. The professional man may earn ten thousand dollars per annum. The capitalist may say that he earns a million dollars per annum; but as a matter of fact he probably earns only ten thousand dollars, and makes up the remainder by his ability to gamble and invest without fear of disaster. No man living can earn a million dollars per annum. It is no evidence of lack of ability among the remainder that comparatively few men are in that category.

The small concern is often the object of intensive deprecatory propaganda on the part of the octopus company, whose salesmen and solicitors hypnotize the prospective client by an account of the immensity of their firm's operations, the multitude of employees on the payroll, the height of the building in which the offices are housed, and the financial standing of the captains of industry who control the destinies of the enterprise. The man in the street is impressed and influenced by such a 'line of talk'. The small operator, on the other hand, must rely almost entirely on efficient and economical working; he cannot afford to distribute largesse in the hope of winning popular favor; he has only the one field of activity; if that fails he becomes bankrupt; he cannot keep going by the appropriation of excess profits from another and more prosperous department. His employees must be content without the thousand and one material advantages that are the perquisites of association with a big firm. How is it, then, that the super-organization is not overwhelmingly successful? We would suggest that the reason may be found in the fact that unwieldiness too often ensues. The personal element disappears; the employee never sees, much less speaks to, his employer. The relationship becomes impersonal; and responsibility is shunned because initiative too often remains unnoticed and unrewarded. 'Passing the buck' is a common sport under such conditions; it is carried on with impunity because the organization is too large to permit the disclosure of the cause of the inefficiency. The officials of a large concern often lack a sense of responsibility toward persons with whom they would be in constant touch were the enterprise of normal size; and in order to stimulate enthusiasm a catchword—loyalty—has been brought into prominence. The word is seldom or never heard in connection with the smaller operations; for under such conditions the attitude of every official is concealable from his chief only with great difficulty; in the majority of cases the mention of the word would hint that something was wrong with the organization. It is personal contact that brings about the prompt elimination of the undesirable; there need be no appeal to "loyalty" in an effort to create a sentiment that is lacking. The work is carried on along mutual lines, grievances are settled at once, no employment manager or welfare official stands between the worker and his employer, between the opportunity for zealous effort and

the prompt recognition of its value to all concerned. The weakness in many big organizations is, therefore, twofold: the worker becomes a cog in the wheel of a highly organized machine, and the ramifications of the concern are so varied and so complex, and conditions are so abnormal, that unsuitable executives are retained, who pass back responsibility to a number of subordinate officials, of whom there are usually a large number in various administrative capacities. To maintain such a combination requires loyalty, and plenty of it.

The reiterated demand for loyalty from the subordinates of an enterprise is too often an indication that something is wrong with the management. True *esprit de corps* cannot be furthered by such propaganda. If an employee shows disloyalty in any form, then something is wrong; either he or his executive should go. The manager or president is as open to criticism as the worker. Mistakes are made by all, except those who are dead and those who achieve nothing. In this connection we recall the story of an eminent man whose personality was gruff and uninviting. At a meeting with his subordinates he called for discussion on any matter of general interest, whereupon one present arose on the spur of the moment and, without authority, voiced the sentiments of those present: "We are continually being disheartened by your attitude toward us," he said. "It is gruff and unsympathetic . . ." And he quoted instances. The executive, who afterward held one of the highest positions in the country, thought deeply for a few moments; and then replied, with emotion: "The accusation is just. The rebuke is deserved". He was a great man, all the greater because he admitted that he was not without fault nor above criticism. Men with a similar breadth of view are needed as executives today; for the director of operations is as fallible as the employee, and the actions of both should be open to just and fair criticism. To shield the inefficiency or unsuitability of an executive by a smoke-screen of spurious loyalty is merely to encourage a state of affairs that causes enormous economic waste and retards the success that should arise from co-operative effort on a large scale.

Blue-Sky Laws

In this issue we publish an address delivered before the recent Mining Convention at Portland by Mr. Sidney Norman, the editor of 'Northwest Mining Truth', of Spokane. We publish this address partly in compliment to Mr. Norman, as an editor, and also because his story of Jim Wardner and the egg-nog is one of the best we have heard for a very long time. Many sayings, some funny, some cynical, have been printed concerning the function of the promoter, but this story illustrates the essence of the promoter's art as no other has done. We commend it heartily to our readers. See page 674. Moreover, we are glad to publish Mr. Norman's address because he expresses ideas with which we disagree and which therefore are likely to interest our readers. Under cover of a plea for protection to the small promoter, he

attacks the blue-sky laws, that is, the legislation enacted in the various States for the checking of unscrupulous methods in company finance, whereby the public is victimized. Mr. Norman considers that these laws check legitimate enterprise and treat the small promoter unfairly. We are disinclined to attack his argument, because, in a measure, he is a guest in our pages, but we can say to him and to our readers that the blue-sky law is operating usefully in our own State, California. In the first place, we venture to assert that the man who honestly purposes to enlist the financial aid of the public in making a mine out of a prospect-hole is under no hardship in California. Of course, the words 'promoter' and 'promotion' cover a multitude of sins and of sinners, both of which it is difficult to classify, simply because the motive of human action is difficult of ascertainment even by the actor himself. The passage of restrictive laws has been prompted by the abuse of public confidence, the misrepresentation of mining properties, and the stealing of corporation funds by means of the mechanism of company organization and corporate finance. In California, the first Commissioner of Corporations, Mr. H. L. Carnahan, and his successor, Mr. E. C. Bellows, have received the cordial support of those engaged in mining because both of them have administered the law justly. In doing so they have been assisted by competent engineers, notably Mr. Fred H. Miller, on whom much of the work of actual investigation has devolved. We have seen nothing to warrant any suggestion that these gentlemen play favorites, that is, treat the big promoter differently from the small one, as appears to be the case in Washington and elsewhere, according to Mr. Norman.

The prime requirement of the Californian blue-sky law is that the business of a mining company shall be planned so as to be "fair, just, and equitable". Any honest prospector or fair-minded promoter, controlling either a virgin claim or a developed mine, need only present a reasonable plan of organization and a definite scheme for prospecting, developing, and operating his property. If he does so, he receives authorization to sell stock for the purpose named and in the amount necessary. Ownership of property is not required, but options to purchase or leases to operate must be fair in terms and must allow reasonable time for the accomplishment of the purpose indicated. The owners or controllers of an equipped and operating mine, desiring to make improvements of plant or of method, may obtain authority to sell more stock, or, if furnishing adequate security for ultimate liquidation, they may obtain permission to sell bonds or other formal acknowledgement of indebtedness. Three fundamental regulations are imposed with the issuance of a permit by the Californian Commissioner of Corporations. These are: (1) The placing of promotion stock in escrow. This applies to all shares or securities issued for any consideration other than cash, or at prices appreciably less than the selling-price at which the company desires to sell its securities. This escrow continues during the financing of the company and until a fair value is created for the subscribed or outstanding stock.

(2) The limitation of the amount of commission, compensation, or other expense connected with the sale of securities to an amount not exceeding 20% of the selling-price of the security; in other words, out of each dollar paid for the security not less than 80 cents must go into the treasury of the company as the life-blood of its enterprise. (3) The permit contains a summary of the facts pertaining to the organization, the conditions of promotion, the property involved, and the plan of business proposed; and a true copy of this permit must be exhibited and delivered to each prospective purchaser of stock before his subscription is collected. Experience has shown that the legitimate promoter is not handicapped by these regulations, whereas they serve as safeguards against the fraudulent adventurer. In short, the purpose is to give the public a run for its money. To limit the law to a discipline of advertising, the issuance of circulars, or other forms of publicity would defeat its purpose; a blue-sky law that provides only for regulating the issue and sale of stock fails to reach the broker or promoter who offers and sells stock that he owns personally or even the distributor of so-called underwritten or optional shares, leaving the field open to some of the most vicious evasions of the spirit and purpose of any wholesome legislation of this character. In the end, of course, the efficiency of the law depends upon those charged with the administration of it; in this State, the results are good because the office of the State Corporation Department is in the hands of honorable and competent men. Mr. Norman deplors the fact that such laws should be administered by political appointees and he recites a case in which a friend of his suffered from their incapacity. Thereupon he suggests that the whole matter of regulation be placed in the hands of the U. S. Bureau of Mines and that the gentlemen now in charge of the various stations of that Bureau be delegated to make the requisite investigations. It seems to us that he prefers the fire to the frying-pan; we have no reason to believe that the scientific men in charge of the Experiment Stations are fitted to adjudicate such matters or to make the investigations precedent to an adjudication. They have plenty to do and they have been selected for the special work they are performing. Such a proposal as Mr. Norman's, if put into effect by Congressional enactment, would necessitate a new organization under Federal control, and Heaven knows we have had enough of regulation from Washington! Moreover, Mr. Norman overlooks, we believe, the principle of States' Rights. We question whether Federal interference in such matters would be tolerated. In any event, it is not needed; what is needed, perhaps, is more uniformity in blue-sky laws, although these must vary with the several branches of industry to which they are applied and with the conditions under which such industries are conducted in the different States. To that end it is desirable that there should be public discussion of the merits and demerits of the regulations now in effect, for the purpose of improving the incidence of such enactments. Mr. Norman's contribution to the discussion is timely and useful.



Valuing Partly Exhausted Mines

The Editor:

Sir—Quoting from your editorial on the above subject (issue of April 9): “It is the sick ones that are offered, because the restoration to health, presuming it to be possible . . .” We find therein, to carry on the analogy, something more than the physical taking of temperature, pulse, and weight, suggested as necessary to a complete diagnosis.

As with the financial expert who blames high prices to a surplus of gold; inflation (high prices) due to an excessive issue of currency (shortage of gold in relation to said currency), “chasing the devil around the stump”, so it seems to me in the case of the “sick mine”.

As with the financier mentioned, Mr. Webber stakes all on one factor entering into the diagnosis. Temperature, pulse, normal or abnormal weight, enter into the doctor’s consideration of his patient. These do not tell all. So with the currency question and the gold question. Supply and demand, shortage of labor, and excess of raw material, a dead market, national debts, all enter into the diagnosis of the diseased condition. An effect here, based on one factor, is the reverse there, based on the same factor.

The impression one gathers from Mr. Webber’s discussion of sampling is that the decision has rested with the diagnosis based on sampling alone. In example D, it would be interesting to know something of the relation of the ore deposit to its country-rock, its relation to eruptive or igneous occurrences and to sediments. This applies to all cases. These items enter into the consideration.

In example E, it would be interesting to know if the “hydrated gangue” is to be considered as an alteration product from the unaltered “bull” quartz below, or may we assume that there was a marked change in the gangue of the lode between these points? The relation of the lode to other geological conditions should suggest something of value to the diagnosis in addition to that of the sampling results. I have in mind the disclosures in the North Star mine (‘Arthur De Wint Foote, of Grass Valley, an Interview’, ‘M. & S. P.’, Dec. 25, ’20) and wonder what the result would have been, at the time Mr. Foote took hold, had the decision been based on the sampling of a depleted mine.

The editorial suggestion for a series of post-mortems on mining ventures would be exceptionally instructive. For example, there must be numerous old reports and recommendations written in the ’nineties or early in the pres-

ent century that could now be sacrificed on the altar of education. Butte, the gold-silver camp of the ’eighties, would have made a sickly showing if considered on the sampling factor alone.

As Mr. Webber says of the persistent propaganda of the several years prior to the War, on ‘What is a Mine’, ‘How to Sample a Mine’, etc., namely, “By failing to realize this, opportunities have been lost of buying a good mine cheaply,” the same can be said, and emphasized, of condemning a mine on sampling alone; of basing the diagnosis on a lone factor. It is a relic of the ante-war days, the “tape and slide-rule experting”.

Some years ago I was placed in charge of a gold mine as superintendent. An inspection of the mine disclosed the fact that there were no stopes from which to obtain ore for the mill. Sampling for information disclosed a few places with values of from \$3 to \$4 per ton; one lone spot on one of the lower levels disclosed a few feet of \$14 in a vein six inches thick. There was a 40-stamp mill on the property; the mine had produced upward of \$3,000,000, returning above 50% in dividends; finally, there was \$32,000 in the treasury, and operations had been a losing game for nearly two years.

Based on the factor of sampling alone, and with any kind of sampling that might be employed—the mill had been running for months, dropping five, ten, or fifteen stamps, as quantity permitted, on ore(?) from the exposed backs—the mine would have been condemned. Taking into consideration the several other factors entering into a diagnosis of the ills of this patient, a course was based on the geology, mineralogy, and history of the orebodies. In three months the treasury was reduced to \$18,000, the mine and mill were on a paying basis, and before again taking ill, produced \$272,000, at a nice profit.

Too much stress is laid on the ‘specialty’. Mines may be recommended and purchased on sampling that, had they been diagnosed by a geological engineer, would have been found without ‘speculative’ value, in the estimates.

Helena, Montana, April 12.

L. S. ROPES.

The Editor:

Sir—In commenting on Mr. Morton Webber’s articles I start by stating that my viewpoint is somewhat different from that of an appraiser, as I have accustomed myself more to an attitude of searching for ore rather than of appraisement of a definite value of a property expressed in dollars. Hence my attitude is one of searching for, with the expectation of finding, indications of new ore regardless of the past history of the property.

In this attitude, when making examination of mines either caved or flooded, there may usually be found geologic evidence on the surface and in neighboring underground openings that will give a general idea of the nature of the mineral deposit under consideration, and the habits of the ore. Usually the outcrop of an ore-shoot is an approximate index to its importance as regards size. A study in detail of all the surface geology should give a general idea regarding probable persistence of the ore in depth with respect to tonnage and value, and its probable chemical change below the zone of oxidation. These surface data, even without the consideration of the stores of the past history and records of production, and consideration of the stope-maps, are sometimes sufficient to show that the property is worth a 'flyer' or that it is uninteresting, from the standpoint of the possible purchaser.

Much can be learned respecting the production of a closed mine from authentic history, and little of value by a Sherlock Holmes method of studying the mine by means of interviews with workmen who have been employed there; but nothing at all may be known of its real value unless the geologic data are considered. If the history only of a closed mine is depended upon, important possibilities with respect to new ore-shoots, and also important possibilities with respect to the favorable changes and adverse changes that may take place in the extensions of known shoots, are likely to be overlooked.

I wish to point out what Mr. Webber does not specifically mention, that an exhaustive study of all the available geologic data will often answer the question as to whether it is probable that the mine is worth the price asked or not. These data, as Mr. Webber says, are entirely distinct and sometimes independent from those of production records or of blocked-out ore, and may lead to a final decision regarding the probable future value of the property without consideration of the historical records. In other words, the exhaustive study of the geological data available may absolutely limit the value of the property to that of the ore in sight, or, on the other hand, suggest probabilities that will place the value of the assured ore in a comparatively insignificant relation. Without an exhaustive study of the geological situation it is impossible to arrive at a proper valuation of any mining property, regardless of the story told by the ore in sight or production records.

Too frequently the engineer depends entirely on artificial data, overlooking the geological story that he might read by spending a few days studying the outcrops and neighboring mines. Frequently this story is plain, and the geologist may almost know definitely that the mine has exhausted its ore at the bottom, or, on the other hand, that there is a likelihood of new shoots being uncovered below the workings or outside of developed area. This detailed study of the geologic conditions is too often given secondary consideration by the examining engineer in preference to the artificial data, whereas it is of prime importance and frequently decisively determines whether the recorded data of history may be made use of at all or not.

One of the valuable points brought out by Mr. Webber is that development money should be spent in the extremity of the deposit where ore must be shown to exist if the mine is to have a future. In this connection I would point out that by the old methods of mining engineering, this extremity might be considered to be only on the extension of known ore deposits, but in the light of modern mining geology it might be that a new ore-shoot could be 'sensed' by the geologist in some undeveloped part of the property, by using the data obtained from an exhaustive study of the geological evidence.

Most certainly we shall all agree with Mr. Webber in the statement, "Theoretically it is better business to buy a gutted mine with a good bottom, than the same mine with an important quantity of remaining ore above the lowest level". May the time soon come when the vendor will be willing to wait a reasonable time for his money, while the buyer, with the faith of his convictions based on geological interpretations, develops new ore with which to pay for the mine, the while he pays expenses out of ore in sight, to the ultimate advantage of all concerned. May we soon see eliminated the vexed situation in which cash payments are demanded for ore in sight, while the purchaser depends upon the false safety promised by the blocked-out ore. The value of a partly gutted mine usually depends more on the undeveloped ore than on the ore in sight, and not at all on the value of the ore already mined.

JOHN A. RICE.

San Francisco, April 18.

Gold in Black Sand

The Editor:

Sir—At the risk of being considered a nuisance I wish to thank you for the most humorous article that has appeared in your columns since your announcement of the discovery of the 'hoothite' vein. I refer to the article on the recovery of gold from black sand in your issue of April 9, which was abstracted from a Bureau of Mines report that was published under the signatures of two of its engineers.

This wonderful black sand consisted of "principally quartz and schist with very little ilmenite and garnet and no magnetite or sulphides. Most of the gold in it was contaminated with quartz". What made it black? Surely not the quartz, the schist, or the garnet.

As it contained 11 cents per pound in gold (\$220 per short ton) it was considered that the "gold content was sufficiently high to justify further treatment", and, in popular parlance, "I'll say it was; I'll tell the world it was".

Why classify it before grinding it? The gold was "contaminated with quartz" and the logical way would have been to grind it at once to sufficient fineness to remove the "contamination" from the gold particles. Surely it would not have been a very hard job to grind 770 pounds to, say, 40-mesh, or finer, if necessary. It could be done in the ordinary laboratory pulverizer in a short time, and if none was available there was the Abbe

mill, which is mentioned and in which it was amalgamated. After grinding, this amount could be readily panned, or worked in a rocker. After panning or rocking, the concentrate could have been amalgamated readily by a little further grinding in a small mortar with quicksilver added.

Why save 8.4 pounds of "canvas concentrate" assaying 0.73 oz. gold per ton, and throw away 217 pounds of "canvas tailing" assaying 2.01 oz. per ton?

A loss of only "2c. per pound", that is, only \$40 per short ton, could possibly have been reduced to 1c. per pound or \$20 per ton by carefully amalgamating the 6-mesh concentrate and amalgamating the minus 6-mesh concentrate four hours longer in the Abbe mill.

A loss of \$15.40, that is, 2c. per pound or \$40 per ton, in an official test for the recovery of gold from 770 pounds of minus 4-mesh product, in an apparently well-equipped laboratory or experiment station, with "Conclusions and Recommendations" appended, is quite a performance. Mr. J. A. Lillie must have been pleased with the result. I am going to suggest that next time that Mr. Lillie has 770 lb. of the same class of concentrate he take it to the nearest old Chinese placer miner and offer him \$5 for cleaning it for him. The Chink will look it over, select a couple of flat stones to use as a grinder, and will grind it down, pan or rock the result, dry the panings, blow out the refuse, and if he loses \$1.54 of the content the drinks will be on me and my sample of 'hootehite' will have disappeared from the cabinet. And just think—if the McFadden Bill is passed, that \$40 per ton loss will be \$60 perhaps!

Some years ago I visited a placer and near the cook-house saw a number of small canvas sacks filled with something and apparently ready for shipment. I was told that they were "black-sand concentrates" and that they went \$80 per ton. I asked to see some of them and a sack was opened; it contained a dry sandy product, of which I took a double handful from the top, and putting it in a pan I stepped to a water-hole in a near-by rock and panned it down. I recovered a bead of quicksilver nearly half an inch in diameter as it lay in the bottom of the pan. Later, I saw a clean-up, and found that the material which had been caught in the riffles was collected in a large tank and then 'streamed down' in a box about 12 in. wide and 10 ft. long. The black sand that went through the streaming-down box was collected, hoisted in buckets, at the end of a hand-line, some 15 ft., and spread on a canvas-covered platform to dry in the sun. After drying, it was put in sacks holding about 60 lb. each and carried half a mile in a row-boat, then packed up a steep bank about 25 ft. and stored alongside a tramway. This tram would hoist about 1500 lb. and cost \$7.50 every time the car was raised to the top. From the top of the tram a team and spring-wagon hauled the black sand to the nearest town at an expense of \$5, and from there it was hauled to the railroad at a further expense of 1c. per pound. The freight bill to the city where it was to be "treated", adding another cent per pound to the cost. By the time the freight, haulage, sacking, dry-

ing, and other labor connected with the saving of this concentrate was paid, it was a loss to the owners of the mine even though the treatment cost nothing. Re-building the streaming-down box and changing the system of streaming down reduced this black-sand concentrate to a value of 47c. per ton. It was not a concentrate, it was the resultant of an improper and careless clean-up. I venture to say that if Mr. Lillie would get a clean-up harrel, such as is used in almost every quartz-mill, and work his "black-sand concentrates" in it in the same manner as battery-sand is worked, he would recover 95% of the gold in short order and at very small expense. No jigging, no Abbe mill, no canvas tables, and no nonsense.

San Francisco, April 14.

G. L. HOLMES.

An Interesting Silver Deposit

The Editor:

Sir—In the spring of 1919 mild excitement was caused in Creede, Colorado, by the finding of silver ore in a "flat vein" near the top of Bachelor mountain, about a mile and a half from town. The original discovery was made by Fred Monkemeyer on the River View claim, on the east slope of the mountain. The bed was traced for a thousand feet to the north and for a greater distance to the south and west. There was a rush to secure leases on that part of the deposit already covered by claims and to locate the unappropriated outcrop. Considerable work was done, mostly with disappointing results, as in only a few places was ore found in workable quantities.

The ore occurs in a bed of tuff, overlain and underlain by hard firmly-cemented breccia, probably belonging to the Middle Rhyolite division of the Tertiary volcanic rocks of the region, as classified by Emmons and Larsen.* The bed, which is nearly horizontal, is from four to eight feet thick. It shows distinct strata, gray, green, or brown. The prevailing tint is gray or buff. The lower strata are thicker and composed of coarser fragments than the upper. Locally there is a good deal of carbonized and silicified wood in the fine-grained upper strata. Fragments of wood are found in all sizes, from what appears to be spruce needles up to logs several inches in diameter. At first it was thought that the whole bed was workable silver ore, but prospecting soon established the fact that only in the places where the wood remains were plentiful was the mineral rich enough to be profitable. In general, the more wood there is the higher the value. Small shipments carrying nearly 1000 oz. of silver per ton have been made, but the average value of the ore shipped is probably about 35 ounces. The total quantity shipped to date will not exceed 1000 tons, mostly from the River View and Mallissa mines.

The origin of this ore is easily explained. The bed of tuff is on the hanging-wall side of the south end of the Amethyst vein, one of the strongest and most productive silver veins in the country. In this vein, small fractures

* Emmons, W. H., and Larsen, E. S., 'A Preliminary Report on the Geology and Ore Deposits of Creede, Colorado'. U. S. G. S., Bull. 530, 1913.

running up into the hanging wall have been important sources of ore in many places. Doubtless some of these "hanging-wall streaks", as they are called, connect with the tuff bed, which, being between impervious walls, offered a natural channel for the silver-bearing solutions that once traversed the Amethyst vein and its branches. When these solutions came in contact with the carbonized wood the silver was precipitated. The other part of the bed, which contained no precipitant, were not mineralized.

HORACE F. LUNT.

Denver, April 18.

Technical Practice in the Philippines

The Editor:

Sir—I am writing you with reference to grinding roll shells and treating refinery slag as practised by the Syndicate Mining Company at present. If you consider either or both items of sufficient interest or value to the mining fraternity, I would be pleased to have you publish them in the 'Press'.

Some time ago we installed a set of 16 by 36-in. rolls. They receive a product, from a Blake crusher, varying from 2 to 2½ in. Tonnage is largely dependent on the degree of fineness to which this can be reduced by the rolls, so it is advantageous to keep them set as closely as possible. We had difficulty owing to the shells corrugating badly and causing too coarse a product from the rolls. We tried carborundum bricks for a while, but could get no satisfaction, as they became clogged with fine particles of ore and no grinding resulted.

On the suggestion of W. G. Carpenter, general superintendent, we made a frame similar to that used on a swinging cut-off circular saw and placed a mandril for an emery-stone on the bottom. This was hung on timbers above the rolls so arranged that it can be shifted latterly to cover all the shell surface and so it can be shifted to grind either the fixed or movable roll. The stone is driven from a jack-shaft hung on the same timbers as the stone and exactly over the centre of the rolls. The only change necessary is to cross the drive-belt to emery-stone when on the fixed roll. When grinding down the shells the rolls are run without feed and the emery-stone, running in the opposite direction to the shell being ground and at a speed slightly higher than the peripheral speed of the shell, is held lightly in contact with the high place desired to be ground.

Since making this installation we have had no difficulty in keeping our roll-shells fairly uniform by grinding on them two or three days in the week for about eight hours per day. We use a coarse emery-stone 2 in. wide by 12 in. diameter. The finer-grained stones are used up very quickly. As the roll-shells wore down, and to enable us to use the stones after they were worn to a small diameter, we had to cut a recess in the housing for the rolls on both sides and at each end; but this is not harmful. The last two sets of shells when removed ranged from about one-sixteenth to one-half inch in thickness.

Owing to conditions it has been necessary for some

time, when cleaning up zinc-boxes, to remove a large amount of short zinc and treat it for the recovery of bullion. It is treated by an oxidizing roast, the product being fluxed and melted in a Case tilting furnace, No. 275.

This has resulted in a large amount of slag, which contains fine prills of gold and assays rather high. Several attempts were made to treat the slag by grinding and panning, followed by amalgamation. In this way the prills were recovered, but the tailing still ran very high. A plan was considered for shipping the slag to the Selby smelter, but the cost per ton ran rather high, owing to ocean freights, several transfers, and the cost of treatment.

We took a small cast-iron cylinder, 16 in. diameter by 40 in. long, fitted with a flange and a head bolted on each end. In each head at the centre a hole was cut and threaded to receive a four-inch pipe for trunnions. This was set on a frame of six-inch timbers and two bearings made for the pipe in each end; the pipe being smoothed off to reduce friction. For the feed, a scoop was made by screwing a four-inch 90° elbow on the end of one trunnion. Into this, a four-inch nipple was screwed and on the end of the nipple another 90° elbow was screwed and riveted to the nipple to act as a shoe-and-scoop opening.

The discharge was connected to a small sluice-box, fitted with riffles and set on a slope of four inches in twelve on account of the high specific gravity of the slag. This sluice discharged into a drag-classifier made of two-inch wood, eight inches wide at the bottom and flared so as to be two feet wide at the top. The classifier was six feet long and was placed on a slope sufficient to enable the scoop to pick up the sand-discharge, thus placing the mill, sluice-box, and classifier in closed circuit. The rakes were made by taking an old chain from a bucket-chain elevator with seven-inch links. A 14-in. sprocket-wheel was placed at the head of the classifier and another one at the bottom and inside the classifier. Several links for attaching buckets were put in the chain and to these were bolted pieces of one-inch angle-iron. The sprockets were placed so that the angle-irons just cleared the back of the classifier and were dragged along the bottom to the sand-discharge. The feed was introduced near the head end of the classifier and the chain run very slowly to give the slag every opportunity to settle.

The mill was loaded with 600 lb. of soft-iron rods from 1½ to ¼ in. diameter and was driven from a slow-speed shaft by a pulley and belt around the mill at a speed of 38 revolutions.

The slag was broken by hand to minus ¾ in., and as a large proportion of it had been granulated in water, much of it was already fine enough. Most of the gold was recovered in the sluice-box as prills of fine metal. The concentrate from the box was smelted directly without further panning. Barren solution from the cyanide circuit was used in the mill and at the discharge to obtain a high dilution in the classifier. The discharge of slime, all of which was finer than 300-mesh, was run into

a 30-ft. Dorr thickener and circulated by a diaphragm-pump. Six weeks were necessary to remove all the gold by this method. If the material could have been run into an agitator, the treatment period would have been very much shortened.

The overflow of solution was run directly to a zinc-box with coco fibre in the head compartment to catch the fine slag, graphite, and fireclay held in suspension, as this material, if introduced into the precipitate, would be extremely difficult to flux.

No trouble was experienced from foul solutions or with precipitation, because the dilution of the slag was so high as to prevent the solution from going higher than \$3 per ton.

The capacity of the mill was one ton of slag in 10 hours and the consumption of power for mill and classifier was approximately 3 hp. It is obvious that there are numerous chances for improvement, such as agitating the pulp, but we had a spare thickener here and no agitator available, so it was more economical to allow the extra period in treatment and to circulate the pulp with a pump. It is advisable when grinding the slag to include the old crucibles and fireclay liners and bricks, as they assist in making the slag easier to circulate; otherwise the slag, even when very fine, has a tendency to pack and choke all the pipes. It is also wise to lock the sluice-box, unless a trustworthy man is on the mill.

The cost of erecting the mill and of materials was low and labor was cheap, so that a considerable saving was effected as compared with the cost of shipping the slag. Seventeen tons of slag in all was treated and the plant is available for treatment of similar slag in the future.

J. O. ENBERG.

Aroroy, Masbate, Philippine Islands, March 5.

Placer Mining in Russia

The Editor:

Sir—Mining engineers will be pleased to know that our friend and colleague Mr. Leon A. Perret is safely out in Japan, now that things are so slow in Russia, and it is interesting to discuss how to operate some of these big and rich placers to best advantage so as to ensure regular and adequate dividends to capital, without which we shall not get very far.

There is no nationality from which a desire to get dividends is exempt, therefore we are really all working with the same object in view. I take it that Mr. Perret would have liked to have seen more capital (foreign or Russian) invested in mining, placer mines for preference, in Russia and Siberia, along about the time of which he writes, prior to 1917, whereas several engineers were looking for suitable properties for that purpose.

On page 415, 2nd paragraph, he says: "Few Russian undertakings can afford to develop their mines adequately previous to extraction, on account of the necessity for recovering the initial expense as quickly as possible. Want of capital, from which Russian placer mining is

suffering, accounts for the adoption of the present method". Cause and effect are obviously misplaced. It is the lack of adequate prospected reserves that causes capital to be withheld, and this is so elementary that it is not necessary to enlarge on the subject. The more frequent procedure is to prospect in the winter for the work of the coming summer. Such a hand-to-mouth policy of working in the dark is unsatisfactory and is apt to lead one accustomed to it to make the remark he does on page 392 under the caption 'Ignorance of Local Conditions', with reference to the Lenskoie company's 17-ft. dredge: "The Lenskoie company can afford to try such an experiment, but I believe there will not be many placer companies in America, to say nothing of Russia, where capital is scarce, disposed to risk such an expenditure at the start. Think of the cost of transporting two or three dredges of that size to an isolated district in Russia". Let me add as a comment: forget the cost for the moment and think of the profit in dredging ground of the "extraordinary richness and extent of the goldbearing channels of that district".

The undertaking was rendered possible by prospecting in advance sufficient ground for the life of the dredges. Proper prospecting goes a long way toward removing the business from the insinuation of the word 'experiment', which might well be applied without such prospecting. Proper prospecting results give information that can be laid on the table, and with the other data necessary helps to dispel ignorance of local conditions, and suggests suitable decisions to those putting up the money. After all, mining engineers the world over are good fellows, including Leon Perret, as I know very well, and can be convinced by the logic of facts, quicker than anyone, and this idea of his of getting around the table so hospitably provided in every issue of your paper for discussion is to be commended.

I well remember in 1912 taking up the work at Nicolo Pavda. This platinum placer ground was then apparently about worked-out; they told me on the property that years previously Mr. Perret had initiated the work with a bedrock tunnel and many of the devices described by him in the article, with excellent results at that time, before leaving for the Schuvaloff property. Had he remained, without doubt they would not have run off the lead, as happened subsequently.

However conditions altered; the ground became deeper, labor a little more costly, and the known deposit was nearly exhausted. Previous observers had considered that the boulders, clay, bedrock timbers, and difficult digging would prove unsuitable for dredging. Briefly, investigation disclosed 26,000,000 yards of good dredging ground of 32 cents per yard at that time and of double that value now. Conditions called for powerful heavy dredges, which were obtained, and success was assured from the outset. I do not believe that Mr. Perret had this property in mind when he recommended light dredges for Russia, as they would have been useless here at Kytlin. This is of no moment, however, as the Second All-Russian Congress of gold and platinum miners at Petrograd in

1915, at which I was present, decided that the industry required 200 dredges.

This illustrates the difficulty of making generalizations, for every property becomes an exception when you are about to spend money in equipping it with a view to getting maximum profits.

This particular part of the Nicolo Pavda property called for four electrically-driven elevator-dredges. One American 7½-ft. electrically-driven elevator-dredge was bought, erected, and started in 1915, working profitably from the first. The power station was three miles away in the forest—the nearest place where conditions were suitable for generating power to advantage. All the near-by forest had been cut down for previous work.

Somewhat reluctantly we installed a steam 5½-ft. dredge manufactured in Russia on easier digging ground which I had recently discovered, owing to the difficulty of getting what was wanted at that time. It was smaller and lighter than would have been selected, but we had to do the best we could. The power-plant was steam, and the boiler was good, so we got a direct comparison as far as possible under our conditions, although the work required of the steam Putiloff dredge was much easier. The American electrically-driven elevator-dredge (similar to Boyle's dredges at Dawson) was digging regularly 3000 yards and the Putiloff steam dredge just half that yardage; both worked about 17 hours per day (local Russian conditions).

The point is that the power-plant of the electric dredge consumed 3½ cubic sages of firewood per day whereas the steam dredge consumed 5½ cubic sages of similar fuel. It is incidental that the firewood cost twice as much for handling when burnt on the steam dredge, per cubic sagine, as similar fuel burnt in the power-house of the electrically-driven dredge. At Nicolo Pavda there was no divided opinion as to whether a steam or an electric dredge should be employed even before we started, but I must admit I did not realize that the difference would be so great. Subsequently two more dredges of American manufacture were purchased and there is every reason to suppose that they will give satisfactory results, as the platinum is there, and we know that this kind of machine is no experiment.

Dividends declared and paid at the end of the 1917 season amounted to 8,000,000 rubles. The stock of the company was then quoted at 450, whereas when I took charge of this work it stood at 67. Assistance was given to this result by a paper factory and sale of wood.

Working expenses of all kinds amounted to 4 cents per yard, and amortization or redemption of capital to another 4 cents per yard, on a basis of ten years life, so that there was considerable profit on 32-cents ground; and then platinum went up. The cost of working was 12 cents per yard, or three times that of the steam dredge.

There are lots of electric-power plants at factories and works in the Ural mountains using De Laval steam-turbines and jet-condensers; these have operated three or four years without delays for power, so that Mr. Perret may feel encouraged to give impartial reference to his

local conditions next time, without being prejudiced by the unforeseen difficulties encountered by the Orsk Gold-fields, as mentioned on page 395. All credit to those men who hung on for the nine long years before realizing their aim. They stayed right with it. I shall take off my hat when I meet any of them again.

This 4 cents per yard for all expenses on the property or 8 cents per yard total (at normal exchange rates) compares well with some of Mr. Perret's figures given, or rather what they were in 1915—not ten years ago. It is good, if you consider that the ground was no longer profitable under the methods of hand-work.

The old tailing-heaps at Nicolo Pavda contained no platinum worth considering, as was proved by exhaustive tests. One must certainly compliment the skilled Russian hand-washers for making a clean tailing when clay does not bother them.

That part of the ground at the Lenskoie properties which it is proposed to dredge is ground that has been abandoned as unprofitable by hand work and bedrock tunneling, the inflow of water being very large. The ground all the way to the surface, about 80 feet, contains some gold, but in less quantity, and will add materially to the yield. Neither the boulders, bedrock, sunken timbers, silt, nor clay will cause any insurmountable difficulty.

Many years ago when work was started, the shafts beside the Bodaibo river were sunk to bedrock in frozen material, but when I inspected the ground in 1916, the recent prospecting had shown that the ground to be dredged had thawed, no doubt from the effect of clearing, circulation of air, and water in the workings, and effect of the river. The surface ground could be thawed if necessary, and I hope that the time will come soon when dredges will get busy at Bodaibo. There is plenty of room on other frozen ground where the other methods so eloquently advocated and so suited to conditions still existing in that far-off gold district may have full scope.

When the Russian people again turn their attention seriously to production, the placer mines of Russia may demand and get better living conditions, possibly throwing the balance over irrevocably in favor of the use of labor-saving methods in that cold country, and it would be better to come out of the draught and investigate these methods in—well, another country in which those methods pay dividends in real money—and I among others will extend to Leon Perret the glad hand.

New York, April 8.

R. S. BOTSFORD.

IN order to secure a unified currency throughout China, the Minister of Finance and the Director of the Currency Bureau have signed an agreement with the Shanghai Mint Loan Bankers' Group for a loan of \$2,500,000, states a consular report. Shanghai Mint treasury notes to the value of \$2,500,000 will be for sale by the group, the proceeds to be employed for the establishment and equipment of the Shanghai Mint. The Government will receive \$93 for every \$100 note and the notes will bear interest at the rate of 9% per annum. There will be a monthly redemption of the principal.

Protection for the Promoter

By Sidney Norman

*In an era of paternalism that has embraced many classes in special privilege or special protection and touched others with the blight of stagnation, it is noticeable that nobody seems to have taken up the cause of the small promoter, who, with undying optimism and unflagging devotion has followed up the prospector's work with initial capital and thus aided in hewing out this glorious West for our use. As a matter of fact, the only legislation directly affecting the promoter and his calling has more or less decried his occupation, covered him with contumely, and placed him—good, bad, and indifferent—in the category of the dishonest.

There has been much discussion of the present status of the prospector and many plans have been proposed to save him from extinction. In British Columbia, from which the United States might with profit accept some suggestions, a real effort has been made to encourage his kind. Many of his problems are solved by resident Government engineers; at the present session of the legislature, \$10,000 will be appropriated to assist bona-fide prospectors in securing powder at a rate cheaper than the prevailing price. On this side of the international line, talk, and then more talk, has been the only result of the nebulous proposal.

It is my opinion that any plan for the betterment of the prospector's position must, to be successful, include consideration of the small promoter. Big capital does not engage in the initial work of developing mines; that has always been the task of the small promoter, who, in close partnership with the prospector, has provided enough capital to carry on the development work to a stage where the interest of big capital could be commanded. If the small promoter be considered in the scheme of things, it is my opinion that he must be accorded some protection from variegated, unfair, paternal, and arbitrary 'blue-sky' laws, now in effect in over thirty States of the Union.

It must be apparent that such men are essential to the development of the West. It is only the adventurous promoter, seeking independence, who will devote himself to the difficult tasks that, from small beginnings, lead to the greater development of our mining resources by big capital. Fired by unquenchable optimism, spurred by the hope of making a mine where none existed before, he has traveled the length and breadth of this land, trumpeting the opportunities of the West. He has sometimes succeeded, more often failed, but, win or lose, he has always been the most eloquent missionary and the most effective publicity agent of our mineral resources. In the last decade the efforts of both him and his partner, the prospector, have been largely circumscribed by paternalism

and over-regulation; and I am not afraid to say that a very appreciable measure of the stagnation we have suffered in the mining industry is ascribable to that fact.

It has often been pointed out to me that 'blue-sky' laws do not interfere with the big promoter, the capitalist, or the producing mine. That is undeniably so, but it is not the big promoter or capitalist to whom we owe the greater debt; that we owe to the prospector and the small promoter, who see only the rainbow in a clouded sky and go through hell on earth to reach the fabled pot of gold.

All mines were once prospects; few, if any, prospects have been converted into mines by big capital. The initial development is always left to the small promoter, who goes forth into the financial byways to collect the contributions of the many who are willing to take a chance. I wonder how far the irrepressible Jim Wardner would have proceeded under the 'blue-sky' laws of your State, for instance?

When he induced Portland capital to buy the Bunker Hill and Sullivan claims nearly thirty-five years ago, he sold a generous proportion of 'blue-sky', backed by his irresistible optimism and contagious disregard of details. The recently discovered orebody, great as it was, lay in an untracked mountain forest; it took nerve and imagination to visualize the future. But Jim Wardner did, and he was able to convey some of his enthusiasm to others.

And from his optimism, his inoculation of 'blue-sky', has grown the greatest mine of its kind in the world, which has already produced \$80,000,000 and paid over \$2,000,000 in dividends. It is equipped with a modern smelter, it employs 1200 men; the orebody gives promise of persisting several thousand feet deeper than the present lowest point, which is 1500 ft. below the Kellogg tunnel and 300 ft. below the surface. Incidentally, one of the most worthy, humane, and important industrial enterprises in the United States has been built up by the men who now direct the company's destinies.

Traced back to its inception, all this is the work of a small promoter. It is not necessary to point out to a body of mining men many specific instances in which properties, generously seasoned with 'blue-sky', have eventually 'made good'. The case of the Granby Mining, Smelting & Power Co. occurs to me as a typical case, however. At the time it was organized twenty-five years ago, the claims of the promoters as to what could be done with an orebody running less than 2% in copper called forth the seathing denials of many engineers prominent in their profession. It was quite impossible, by all the rules of precedent, they said. And yet a small promoter, at that time heavily in debt and possessing nothing but nerve and faith, accomplished the impossible to the

*An address delivered before the Third International Mining Convention, at Portland, on April 8, 1921.

benefit of the North-West and of the world. His dream has already resulted in the payment of over \$10,000,000 in dividends, the erection of two large smelters, and the expenditure in labor and supplies of certainly over \$50,000,000.

Speaking of Jim Wardner, one of the really picturesque characters of the mining West, reminds me of a story containing a good definition of 'promoter'. In the early days of the mining town of Wardner, named after him, Jim was having a particularly hard time and was completely down in the mouth. It was cold and uncomfortable in the primitive shacks that did duty for hotels in those days; and one morning, thoroughly disgusted, Jim realized that he was without a cent and very much in need of a 'braeer'. He went over a mental list of bartender's wares and decided that, above all things, he would like a real sure-enough egg-nog. With Jim, to desire a thing was to go after it. So he walked over to an acquaintance with a little more worldly wealth than he possessed and asked him if an egg-nog would not tickle his palate that particular morning.

"Sure", said the man, "but how in hell are we to get it here?"

"Tell you what I'll do," said Jim, "If you'll supply the liquor, I'll find the eggs."

"Done," said his friend, "go ahead and get your eggs."

Then Jim walked over to the leading store and said to the proprietor: "Say, Jack, how would you like an egg-nog this morning?"

"Best on earth," said Jack.

"Well," said Jim, "tell you what I'll do; if you'll furnish the eggs, I'll furnish the booze."

"You're on," replied Jack.

So off they started for a saloon, armed with three or four eggs without much pedigree. The other fellow was picked up on the way and pretty soon three fine-looking egg-nogs were pushed across the bar. As the mixologist started the last toward Jim, the man who had paid for the 'booze' grasped the situation and made a belated movement to draw the glass back, just as Jim's hand closed over it like a vise.

"Here," said he, "where do you come in, Jim?"

"I'm the promoter," snapped Jim, as he drank it down.

While in these days I would rather have the job of providing the eggs than the 'booze', I think this story defines what a promoter is. He is one who makes something out of nothing and generously shares what he makes with others.

It is understandable to me why Eastern States with no mineral resources to develop should legislate against the removal of capital to the West; but, as a matter of fact, 'blue-sky' legislation in Eastern States has not proved satisfactory. Only last year, the Iowa Bankers' Association drew attention to the serious condition which had arisen in the State through the stamp of approval placed by its law upon worthless promotions. Millions of dollars were being taken annually from the savings of the people

by dishonest men who received from the State a warrant to go forth and rob.

Nebraska's law has also been found unsatisfactory, and there was some talk of repeal during the last session of the legislature. I am not advised as to how the effort fared. So far as Western States are concerned, I cannot for the life of me understand the spirit that prompts the enactment of half-baked restrictive laws that bear with annihilatory weight upon the mining industry. Arizona, California, and your own State among others have passed such laws and I think it is the consensus of opinion that they have largely failed in their purpose of protecting the public; at the same time they have helped to destroy the spirit of venture that must be preserved if mining development is to be carried on.

The trouble with most 'blue-sky' laws is that they do not prevent failure or loss, but always act as a brake upon the initiative of the honest and energetic. Perhaps the actual experiences of a Montana friend of mine will illustrate more clearly the difficulties that now beset the small promoter's path.

He was interested in a district which had been quiescent for many years, but which was again brought to the front by the advance in the price of silver. He resurrected an old mine, and, after putting it in shape for economical operation, set out to raise \$250,000, to complete his plan of development. By the by, it might be well to say here that he eventually succeeded and added one more producing and profitable mine to Montana's long list. Before he succeeded, however, he met with much grief.

First, he went to Michigan, where a great many old friends resided, and was compelled to go before the Securities Commission, consisting of five men, including the State Bank Examiner, Secretary of State, and Attorney General. The commission sent out a representative to make an examination—in this case a young boy who had just graduated from mining college. He was absolutely unfamiliar with Western ore deposits and, in fact, had never been West before. He made a cursory examination of the mine, inquired as to the standing of my friend the promoter, and reported to the Commission that the property had merit and was worthy of a flotation price of \$250,000, which was just the net sum my friend needed. As the brokers handling the stock wished to sell it above par to provide for commissions and other expenses, the State refused to grant a license until the mine could be proved productive.

Then my friend moved on to Ohio, where all mining securities must be submitted to one man, a political appointee. Again a representative of the State was sent to examine the mine, in this case one who previous to his appointment had been in the real estate and insurance business. He 'examined' the mine, perhaps with the imagination of a real estate speculator, and recommended that a permit be issued for sale of stock in Ohio at four times par, or \$1,000,000.

Thus, by moving from Michigan to Ohio, my friend had increased the official value of his mine 400%, which

may be considered a very fair few weeks work. The experience teaches the absolute folly and impropriety of any State attempting to place valuations upon speculative property, one of the glaring mistakes of 'blue-sky' laws in general.

My friend later visited Illinois, where the same conditions were met with, and Connecticut, where 'blue-sky' protection appears to be limited to mining and oil securities. Continuing his financial search, he visited most of the States in the East, ascertaining that none of the New England States, with the exception of Connecticut, or the State of New York, Indiana, Pennsylvania, New Jersey, or Delaware, has yet been bitten with the 'blue-sky' craze. Finally, my friend opened offices in Boston and New York and conducted by mail in many States a campaign he was not permitted to make by specific laws of those States.

This points to the obvious conclusion that nothing short of a Federal law can control the mail-order stock salesman, who, to my mind, has been productive of the greatest amount of dishonesty in the promotion business. I believe those who know me best will give me credit for desire to inject all the honesty possible into the business of mine promotion. I have done what I could in my publication to discourage the crook and to help the small man who is struggling to finance a legitimate proposition. It is undeniable that the business is often disgraced by flagrant dishonesty, but in my opinion the occasions are no more frequent than in other lines. We do not have to look back far to find instances of deliberate dishonesty in the banking business, in the bond business, in the public utility business, or, in fact, any other in which some element of chance is unavoidable and in which shifting conditions may upset all calculations. And yet, we do not advocate laws to drive the banker, or the bond dealer, or the railway builder out of business.

I object most strenuously to the basic principles which underlie the average 'blue-sky' law, by which arbitrary power is built up and a political appointee given the right to say whether or not a project is worthy, or whether a promoter is honest or dishonest. No law worthy of the name 'American' should deny a man 'his day in court' under constitutional law when charged with or suspected of crime. Any law should state specifically how it may be complied with; when its provisions have been fairly met any citizen should be allowed to go about his business without let or hindrance just so long as he stays strictly and in good faith within the law. No law can be good law that sets aside constituted authority and raises up an individual with plenary power to control at will the actions of other men.

It is patent to me that if you eliminate the hope of great reward, you will also kill the spirit of venture that prompts the average man to put his luck to the touch. A fool cannot be protected from his folly short of the four square walls of a lunatic asylum, and there is no just reason why honest endeavor should be restricted in pursuit of the impossible. In any event, the criminal laws provide ample means for punishing the dishonest, and my observation has been that 'blue-sky' laws do nothing

of value in the way of protecting the credulous or ignorant.

Perhaps the wave of interference and restriction is on the ebb. At least I hope so. Both Montana and Washington have just refused to place drastic 'blue-sky' laws upon their statute-books, and possibly the time will come when other Western States will awake to the fact that the development of their natural resources is being seriously retarded by suppression of the spirit of venture, which must always be preserved unless the entire work of mining development is to be given over to the large company fortified by big capital.

So far I believe the majority of mining men who have listened to me will agree in the main with what I have said. As to methods of improving the conditions which confront the small promoter, good men differ. Unification of 'blue-sky' laws is the remedy most often suggested, and there can be no manner of doubt but that it would be the most effective way. I do not believe, however, that it could be brought about, at least not in time to benefit the present generation. Within that time the small mining promoter might become as extinct as the dodo, or his own side-partner, the prospector. I have no desire to introduce a controversial subject, but it is my impression that conditions will never be changed for the better until a Federal law supersedes all State 'blue-sky' laws. There is no greater enemy of bureaucracy than am I, but I would rather submit to one more Federal bureau of control than over thirty State bureaus that are now strangling development of Western mineral resources.

In this audience are men unalterably opposed to further governmental interference with business and, knowing the injustice and petty tyranny to which they have been subjected, especially in the conduct of big mining operations, in the past five years, I most deeply respect their opinions and do not blame them for the attitude they have assumed. It is obvious, however, that such a Federal law would not interfere with the operations of large concerns; in fact, it would only control the efforts of those who sought to raise capital in a general way from the public.

Briefly, my suggestion is that a national effort be made to secure enactment of a Federal law by which a corporation department of the Bureau of Mines be constituted the clearing-house for new mining and oil corporations seeking capital. The law should be specific, saying just what must be done to comply with it, and when its provisions have been met, and a corporation's good faith established to the satisfaction of those in charge of administering the law, a permit must issue allowing any honest man to seek capital in any State of the Union.

Compliance with the provisions of such a law could be made easy by delegating power to accept applications at the Bureau of Mines stations now in operation. Any obvious misstatement in applications could thus be checked at the source, and, in cases where it became necessary, examinations could be made to ascertain whether or not fraud was being attempted. Such a Federal law could also bring every seeker for capital under the postal laws and thus enable the Government to stamp out, once

and for all, the mail-order promoter of the get-rich-quick type, who now constitutes such a drain upon the savings of the ignorant.

In my opinion such a plan would rid the mining business of many barnacles of dishonesty, it would provide the fullest possible protection to the unwary and ignorant, and at the same time it would allow the maximum opportunity for honest men to engage in the patriotic work of developing the great mineral resources of the West.

I fully realize that such a plan as I propose involves some important legal and constitutional questions, upon which I am not fully advised. Whether or not States rights in such matters could be superseded by a Federal law I do not know, but I am advised by well-informed attorneys that they could, provided that in the opinion of Congress the matter was national in scope and could only be handled properly by Federal law. Failing that, however, I believe the same end could be gained by acquiescence of the States now carrying 'blue-sky' laws upon their statute-books. It would take time, of course, but, in my opinion, the effort would be well worth-while.

I give you this thought as one who has studied the 'blue-sky' question intensively in the last few months, and as one who has thoroughly convinced himself that the rapid elimination of the small promoter by restrictive meddlesome laws has been a serious blow to the mining industry of the West. The suggestion may be at least worthy of discussion and thought.

Handling of Explosives

The facts developed in the administration of the Explosives Act of October 6, 1917, emphasize the need for close supervision over and control of the manufacture, storage, transportation, and use of explosives in order properly to protect the people of this country from accidents occurring from them or outrages committed with them, is the conclusion reached by Charles E. Munroe in Bulletin 198, of the Bureau of Mines. As has been pointed out, this may be accomplished by the enactment of a uniform law by each of the States and by the United States to cover its Territories, the District of Columbia, and all other possessions, if such laws are uniformly administered, or, by a single Federal law operating throughout the land. The following is offered as a proposed form of peace-time legislation which if enacted into law would, when efficiently administered, go far toward securing the protection needed: For investigations of explosions and fires caused by explosives in mines, quarries, factories, warehouses, magazines, houses, cars, boats, conveyances, and all places in which explosives or the ingredients thereof are manufactured, distributed, stored, or used, with a view to recommending safe methods for the manufacture, distribution, storage, and use of explosives to the end that precautions may be taken to prevent such explosions and fires, and including personal services in the District of Columbia and elsewhere, printing and binding, supplies and equipment, traveling and subsistence expenses, maintenance,

repair, hire, and operation of motor-propelled passenger-carrying vehicles, \$35,000 or so much thereof as may be required for expenses incurred in connection with the work during the fiscal year . . . *Provided*, That the Director of the Bureau of Mines shall, in his discretion, report his findings, in such manner as he may deem fit, to the proper Federal or State authorities, to the end that if such explosion or fire has been brought about by a wilful act the person or persons causing such act may be proceeded against and brought to justice; or, if said explosion or fire has been brought about by accidental means, that precautions may be taken to prevent similar accidents from occurring.

The United States, says the bulletin, is practically the only civilized country in the world that fails to exercise a national supervision over the manufacture, storage, and use of explosives; in time of peace it is easier to obtain explosives in this country than in any other. Some of the States have no laws relative to explosives; in others, explosives may be obtained for any purpose. Large stores of explosives have been found by the Bureau of Mines within the limits of cities and towns where an explosion might have caused loss of life, limb, and property. Powder magazines are in many cases of improper construction, not proof against fire or bullets, and without guard protection. Not a few accidents to children have been attributable to the careless manner in which powder magazines are locked or secured, and to the abandoning of explosives in quarries and excavations. Occasionally, miners have taken frozen explosives home for the purpose of thawing them, and have blown up themselves and their homes. There have been instances where State convicts have used dynamite in their work on the public roads, have left it hidden, and, when their terms have expired, have recovered the explosive and used it for safe-blowing or other criminal purpose. The wholesale destruction of fish by the dynamiting of streams is a common offense. The protection of citizens and of property against bomb outrages is a matter closely connected with proper explosives regulation. Explosives are fundamental necessities of modern civilization, and their uses in industry are so varied and extensive that safe disposition and employment is a matter of importance to every citizen. For economy and efficiency in use, it is imperative that explosives should be readily accessible. As a result, they are distributed like other general merchandise, and in the absence of regulation and supervision, may be obtained by anyone. On account of the extended use of explosives during the War, thousands of persons acquired a familiarity in handling and use. With State regulation, there could be an accounting for explosives manufactured or used and means of guaranteeing safe storage. The bulletin mentioned reviews the work of the war-time regulation of explosives that was entrusted to the Bureau of Mines. In the course of the War, 16,000 agents were commissioned by the Bureau to assist in this regulation; half a million licenses for the manufacture, sale, or use of explosives were issued; ninety convictions for violations of the Federal explosives laws resulted.

Tom Reed Gold Mines v. United Eastern Company

Abstract of Decision by the Superior Court of Mohave County, Arizona

On January 1, 1904, Ely Hilty located the Grey Eagle and the Bald Eagle claims in the San Francisco mining district, at Oatman, Arizona. These locations were amended on January 10, 1909. The territory as included in these amended locations comprises a part of the estate of the Tom Reed Gold Mines Co., the plaintiff in this case. It owns this ground by virtue of a patent, dated October 31, 1917.

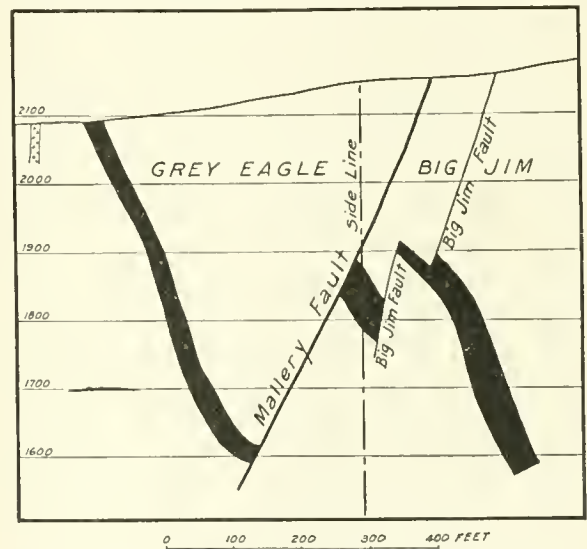
On September 2, 1908, the Big Jim claim was located by S. S. Jones, B. L. Lunsford, and W. L. Corbier. At the time of this location these parties were employees of the plaintiff company, and S. S. Jones had charge of the property of the plaintiff company. The location of the Big Jim claim was prior to the amended locations of the Grey Eagle and Bald Eagle claims. The locators were citizens of the United States and the territory embraced within the Big Jim location was then a part of the public domain, and no evidence was given to indicate any bad faith upon their part. On that date the ground was subject to location by them or by any other citizen.

The United Eastern Mining Co. is the owner of the Big Jim mining claim and derives its title from the Big Jim Gold Mining Co., which company secured a patent to said ground. The Tom Reed company did a very limited amount of development work on the Grey Eagle and Bald Eagle claims prior to 1916. This work on these two claims consisted principally of two shallow shafts, one of them probably ten or twelve feet deep and another about 40 ft. deep, but during that period plaintiff company was engaged in extensive mining in the district. The defendant company and its predecessor in title, the Big Jim Gold Mining Co., during the year 1915 and since have performed very extensive development work beneath the surface of the Big Jim claim. The result has been the development of an orebody valued at more than two million dollars, which orebody lies beneath the surface of the Big Jim claim.

On March 1, 1919, the plaintiff filed this suit against the defendant, to quiet title to certain portions of what it alleges to be a part of the lode belonging to the Grey Eagle and Bald Eagle claims. The case was brought to trial on November 8, 1920, before the Court without a jury, said trial being concluded on November 15, 1920. On December 1 and 2, 1920, the Court, in company with W. B. Phelps, representing the Tom Reed company, and Horace V. Winchell, representing the United Eastern company, viewed the premises in question. This view of the premises included an inspection of the various points both upon the surface and beneath the surface of these claims. On February 21, 1921, the case was presented by oral argument, at the conclusion of which it was submitted upon briefs.

The issues in this case present a suit to quiet title to an underground vein or orebody situated beneath the surface of the Big Jim claim, which claim is patented and owned by the defendant. The plaintiff owns the Grey Eagle and Bald Eagle mining claims and they are, also, patented; and said plaintiff is claiming the ore in question by its alleged extra-lateral right under what is known in mining parlance as the apex law. This law, as expressed in Section 2322 of the Revised Statutes of the United States, reads as follows:

"Locators shall have the exclusive right of possession and enjoyment of all the surface included within the lines of their locations, and of all veins, lodes, or ledges,



throughout their entire depth, the top, or apex of which lies inside of such surface lines extended downward vertically, although such veins, lodes, or ledges may so far depart from a perpendicular in their course downward as to extend outside the vertical side-lines of such surface locations."

This section gives to every mining claim, whether patented or unpatented, not only the surface within the lines of said location, but the subsurface, subject to the apex rights of the owner of some other claim whose vein may enter the subsurface on its downward dip, and, in addition to the grant of the surface and subsurface, the owner of any mining claim has the right to follow his vein, lode, or ledge on its downward dip through its side-lines. In other words, the owner of a claim who has the apex within his boundary lines may pursue said vein on its dip downward outside of the vertical side-lines of such claim. This right is given by the apex law, but said right does not include the right to run a horizontal tunnel from the owner's claim into an adjoining claim owned by another party. The owner of the apexing claims does

not have this right, even though it might be essential for him to exercise it in order to reach his vein. The theory of this rule of law is that the adjoining owner has the common-law right and title to all of the other ground within his claim, except the right of apex. The patent for a lode claim not only gives title to the surface, but to the subsurface, that is, everything under the surface except what may belong to someone else because of his apex rights.

The action of the Mallery fault is the cause of this lawsuit. A fault is merely a vein which is not mineralized. It seems that faulting results from strain which accumulates in the rocks of the earth. Two of the most important causes of this strain are the operation of temperature within the rocks and the moving of weighty material from one place to another on the surface. By these movements the ordinary balance was distributed and corrected by the flow of material from below, and thereby the balance was restored. When these strains have accumulated to a point beyond the strength of the rocks, they cause the rocks to break and slip, which breaking and slipping is what is known in geology as the faulting. The Oatman district has also been lightened by erosion. A great deal of material has been moved eastward into the Sacramento valley and westward toward the Colorado river. At some time in the past, when hot waters were percolating and circulating through the openings of the rocks, the early fault-fissures of the Oatman district were mineralized, and when these faults became mineralized they then became what are known as veins. At some time later, when strain was developed in the rocks by other causes, there was a recurrence of faulting, and at this later time the movements dislocated and passed through the older fault which had become mineralized. Because the faulting which created the Mallery fault occurred at a later time and at a time when the temperature was not high, mineralization did not take place, and, for that reason, what is known as the Mallery fault is simply a fault instead of a vein.

We have established in the Oatman district two fissure systems: the older system which was mineralized, as exemplified by the Tom Reed vein, and the later system, which is not mineralized, as exemplified by the Mallery fault.

This case is governed by the law of the apex. It is essential to determine what is meant by an apex when used as a mining term. An apex is the top or highest part of the vein. For instance, commencing anywhere upon a vein and following the line on its dip to the highest point on said vein at which vein matter is found in the fissure of that vein, you arrive at its top or apex. This top or apex forms the terminal edge of the vein. If this terminal edge reaches the surface, it is called the outcrop. However, it does not have to reach the surface in order to constitute an apex. And the apex of any given vein is all that portion of its top or terminal edge from which the vein extends downward on its dip.

The word 'apex', as used in the Federal statutes, means the highest point in the vein. An apex must be the top

or terminal edge of the vein either on the surface or the nearest point to the surface, and must be the top of the vein proper rather than the top of a spur, and it must be a point from which the vein has a dip and a strike. A vein, lode, or ledge means a more or less continuous body of mineral lying within a well-defined boundary of other rock in the mass within which it is found; in other words, the body of mineral within defined boundaries in the general mass. It is not always a straight line, neither is it uniform in dip or thickness or richness of mineral matter throughout its entire course. It may be narrower in some places than in others, or it may close up for a short distance and then be followed further on. The mining acts of Congress do not define the terms vein, lode, or ledge, but as these terms are used in the Federal statutes they are applicable to any zone or belt of mineralized rock lying within boundaries clearly separating it from the neighboring rock. It includes all deposits of mineral matter found through the mineralized zone or belt coming from the same source, impressed with the same forms, and having been created by the same process. Geologists say that it is a fissure in the earth's crust filled with mineralized matter.

The vein that traverses the Grey Eagle and Bald Eagle claims lengthwise and what the plaintiff has called the 'first segment' of the Tom Reed vein, has its apex within the surface lines of those claims. Since the first of the year 1916, the plaintiff has mined the ore from this vein to a depth of 600 ft., and at that depth the vein stops abruptly against what is known as the Mallery fault. At the bottom of the vein the ore is bent upward on the hanging wall of the fault. At a distance of about 430 ft. from the 600-ft. level of the Grey Eagle, the orebody which the defendant terms the Big Jim vein and which the plaintiff terms the 'third segment' of the Tom Reed vein, stops against the foot-wall side of the Mallery fault. The ore in this vein is bent downward. The top of this orebody is about 200 ft. beneath the surface of the Big Jim claim. There is a much smaller orebody along the foot-wall of the Mallery fault between the 200-ft. level of the Big Jim and the 600-ft. level of the Grey Eagle. Experts for the defendant term this the Sideline vein. Experts for the plaintiff term this the 'second segment' of the Tom Reed vein. It is more or less a jumbled-up mass of ore that has been dragged down from about the 200-ft. level at the time of the faulting. Part of this ore is on one side of the common side-line and part of it is on the other. In order to reach the main orebody within the Big Jim, the plaintiff would either have to travel up the Mallery fault a distance of 430 ft. from the 600-ft. level of the Grey Eagle, or cross-cut through country-rock mostly beneath the surface of the Big Jim for about the same distance.

After listening to the testimony of the geologists, and after reading and re-reading the same, the Court is of the unqualified opinion that at some time in the dim and distant past, the orebodies beneath the Tom Reed property and the orebodies beneath the United Eastern property were once connected as a part and parcel of the same

general fissure and vein system, but this Court has no information as to just how many thousands or how many millions of years have elapsed since that condition existed, but that it at some time in the past did exist seems to be the opinion of all the expert witnesses on both sides. But when the faulting occurred as the result of the formation of the Mallery fault there was not only a downward displacement of approximately 430 ft., but there was a horizontal movement, the extent of which is not known, and the best proof which could be introduced as to the size of the horizontal component would be nothing more reliable than a wild guess. For instance, there is nothing before this Court that any part of the vein along the 600-ft. level within either the Grey Eagle or Bald Eagle claims was ever attached to any part of the top of the vein as found at the 200-ft. level within the surface of the Big Jim claim. About the only testimony on this point was to the effect that the horizontal movement was greater than the downward displacement.

This case involves nothing more than a novel question of the apex mining law. During the course of the trial there was not much dispute or serious conflict between the expert witnesses on both sides. The essential facts relating to existing conditions were practically admitted. The law of the case simply calls for a construction of the Federal statute, Section 2322, under which the suit was brought.

Every man is required to keep his hands off any and everything within the surface lines of a claim belonging to another, which surface lines extend vertically downward, until he sustains the heavy burden of proof that he is working upon and following the vein which has its apex within the surface lines of his claim. This apex right only attaches to the vein of any claim when said vein may be identified on its downward course and when it is a continuation of the same vein both without and within the lines of his claim; in other words, in order to assert this right of apex the vein outside must be identified with and a continuation of the vein inside of the lines. Identity and continuity are essential to the exercise of apex rights, and after the identity and continuity of the veins have been proven, there must also exist the continuity of right, as indicated by the statutes. The mineral deposit within any lode or vein may be reduced or disappear for a short distance, but if it is found again in the same general course with the same mineral within a short distance, there is a presumption of identity, but if the mineral entirely disappears, or the walls of the fissure stop so that its identity can no longer be traced, the right to follow such a vein outside the apex owner's claim is gone. If veins are separated permanently and cannot be followed as the same vein, and if it is necessary to pass through great distances of country-rock in order to connect them, in which distances there are neither mineralized walls nor seams, such veins must be deemed separate and distinct ones and cannot be identified as one and the same. The connection between an apex and the orebody in dispute can only be made by following the continuous streaks of body of quartz or ore, or by

passing through vein-matter, and such connection cannot be made by following such material or indication as the practical miner would follow in the expectation of finding ore.

The burden of proof is always upon the apex claimant. What may constitute a sufficient discovery to warrant a location of a mining claim may be entirely insufficient to justify the locator in claiming or exercising the rights reserved by the statute. That which constitutes a discovery that will make a location valid is a very different thing from what constitutes an apex to which attaches the statutory right to invade the possession of and appropriate the property which is presumed to belong to the adjoining owner. It is the object and policy of the law to encourage the prospector and miner in their efforts to discover mineral, and, therefore, as between conflicting lode claimants, the law is liberally construed in favor of the senior location. But where one claims what *prima facie* belongs to another because of the apex in the claimant's location, a more rigid rule of construction against the claimant prevails.

This case must be decided from a practical viewpoint as the miners find conditions in the ground today, or it must be decided upon the theories and testimony of geologists in accordance with conditions as they existed many thousands or millions of years ago. If the decision be based upon the theory and testimony of the geologists, it seems to me that no mining location in the Oatman district could be secure or valid. The fundamental purpose of the apex law was to give the miner what he found. The law was passed for his benefit, a reward to him for incurring the hardships incidental to the life of the prospector. When Ely Hilty located the Tom Reed vein on January 1, 1904, could it be said, under the theory of the geologists, that he discovered the orebody beneath the Big Jim claim, taking their testimony not only as to the downward displacement of 430 ft., but as to the horizontal movement? In order for Ely Hilty to prove identity, continuity of right to the vein which he discovered on that date, he would have to travel a great distance in order to find a continuation of his vein or that part of it which was attached to his discovery before the Mallery fault occurred.

We are reliably informed by geologists that this northwest section of Arizona, including the San Francisco district, experienced at some time in the past a great upheaval and sank about six thousand feet. With this in mind, the Court is compelled to view this case from a practical standpoint and adopt the views of the practical miners, and view the conditions as they are today and as they were when the rights of all parties herein were acquired.

Continuity of right means something different from the continuity of a vein. For instance, under the apex law, the identity of a vein may be clearly proven and said vein may be shown to have such practical continuity as will comply with the law and still there would not attach to said vein that continuity of right which would entitle the apex owner to follow said vein into the claim

of an adjoining owner. For instance, suppose that when the Tom Reed vein reached the 600-ft. level of the Grey Eagle claim, instead of stopping abruptly against the Mallery fault, as it does, it spread out and extended on laterally into the subsurface of the Big Jim claim. Under the apex law no extra-lateral right attaches to a blanket vein or one that extends laterally. Again, suppose that the Tom Reed vein, instead of stopping abruptly against the Mallery fault at the 600-ft. level of the Grey Eagle claim, bent upward and extended upward along the plane of the Mallery fault. Under the apex law no extra-lateral right attaches to a vein on its upward course. The statute which grants this right says "downward course" or "course downward". "Course downward" or "downward course" means, in so far as the apex statute is concerned, going down from the apex of the vein on the dip of the vein practically within the plane of the vein toward the centre of the earth. It may be argued that such a construction is unjust and is calculated to deprive apex owners of their legal rights. It might be argued that there are many veins which have a displacement of only a very few feet and that there could be no denial of their identity and practical continuity. There is no reason for such an argument in this case, because the downward displacement is over four hundred feet, and the lateral or horizontal displacement is greater than that and probably several thousand feet. It would be an impossible task to frame a rule that would do justice in all cases. In fact, lawsuits upon most subjects are not decided by any ironclad rule. Each and every case stands upon its own merits. Again, suppose that instead of this vein system having been cut in two by the Mallery fault, that it had been cut in two by another mineralized vein. Could it be argued that when the plaintiff followed its vein down to the 600-ft. and found another vein, it could then follow that vein upward 430 ft. and connect with the detached part, even if there had been no lateral or horizontal displacement? Section 2322 of the Revised Statutes of the United States does not grant extra-lateral rights under such conditions. In that event the plaintiff would not be following its own vein, but following an entirely different vein, though at some prehistoric time this second vein was located some place else or had not been found. These geological theories lead entirely too far into the uncertain realms of speculation and doubt. The lawmakers who framed the statute used the term "course downward". The law is an incentive to the miner to go down into the bowels of the earth and search for hidden treasure. It was not intended as a technical device to furnish an excuse for acquiring, through the agency of geological speculation, property which more rightfully belongs to another.

As stated before, the three essential conditions to be established in this case are *identity*, *continuity*, and *continuity of right*. The burden of proof rests upon the plaintiff. Unless plaintiff has established by a preponderance of the testimony the existence of these three conditions regarding the orebodies found within the premises

in question, its case must fall. The plaintiff introduced a great deal of convincing testimony as to identity. Among other things it proved that the ore is abruptly cut off and exists on opposite sides of the Mallery fault, that the strike and dip of the various orebodies are similar, that the vein-filling is virtually the same, that the wall-rocks are similar, and that, on the hanging-wall side of the Mallery fault the ore is bent upward while on the foot-wall side of this fault it is bent downward. But the plaintiff did not identify the ore which is located beneath the surface of the Big Jim claims as the continuation of its vein, known as the Tom Reed vein, which stops abruptly against the Mallery fault on the 600-ft. level of the Grey Eagle and Bald Eagle claims. This identity and continuity of the Tom Reed vein within the plaintiff's ground into the ground of the defendant was not proven and could not be proven, if for no other reason than because it would be impossible to ascertain the extent of the horizontal movement at the time of the formation of the Mallery fault. When a locator locates a mining claim, his claim is limited to 1500 ft., and his apex or extra-lateral rights are also limited on that claim to the same distance. These rights may be limited to a much shorter distance.

Whatever may be the length of the owner's terminal apex is the extent of his extra-lateral rights. For example, when a vein enters the end-line of a claim and continues nearly parallel with the side-lines for a part of the length of the claim, an owner of the claim can only exercise extra-lateral rights from the end at which the vein enters to the point at which it crosses the side-line. In other words, if an owner has the terminal edge of a vein within his claim for any given number of feet, he is only entitled to the same number of feet on that vein after it extends through his side-lines into the ground of the adjoining owner. Under this rule of law, because of the horizontal movement found to have occurred in these premises, and independent of other existing conditions which affect its rights, plaintiff has failed to sustain the burden of proof as to whether or not it is entitled to extra-lateral rights for any distance whatever on the Big Jim vein located within the property of the defendant. The burden of proof was upon the plaintiff to show that the orebody constituting the Big Jim vein and located beneath the surface of the Big Jim claim, is identical with and a continuation of the vein or orebody which it worked down to the 600-ft. level, which burden of proof plaintiff has failed to sustain. The testimony of all the geologists who testified in this case shows that the continuation of the Tom Reed vein on the foot-wall side of the Mallery fault is at least over 400 ft. from where it was once connected and attached to the Tom Reed vein, and probably several thousand feet from either the Grey Eagle or Bald Eagle claims. The testimony shows that these two orebodies were once part and parcel of the same fissure or vein system and that the Big Jim vein, as found beneath the surface of the Big Jim claim, is not identical with and a continuation of the Tom Reed vein, as found beneath the surface of the Grey Eagle and Bald

Eagle claims. In order to prove the identity which the law requires, it would have to be shown that the Tom Reed vein at the 600-ft. level of the Grey Eagle and Bald Eagle claims was once attached to and formed a part of the orebody constituting the Big Jim vein, and, therefore, the Big Jim orebody was a continuation of the Tom Reed orebody. This was not proved, but the testimony merely showed that they were, at one time, a part of the same general fissure or vein system. A fault which causes a downward displacement of over 400 ft. and a horizontal component of that much displacement or a great deal more, destroys the identity and continuity of the vein and deprives the apex-owner of his continuity of right to follow that vein under such conditions into the land of an adjoining owner, and Section 2322 of the Revised Statutes of the United States grants no extra-lateral rights under such circumstances. This Court has no power to enlarge the provisions of that statute. The plaintiff in this case has not established its continuity of right under that statute, because plaintiff cannot start on the apex of the Tom Reed vein, proceed on a course downward, on the Tom Reed vein, along the dip of the Tom Reed vein, practically within the plane of the Tom Reed vein, and reach the orebody found within the Big Jim vein beneath the surface of the Big Jim claim, owned by the defendant.

The Court finds that within the premises in question there exist at this time three separate and distinct veins or orebodies, namely, the Tom Reed vein, the Sideline vein, and the Big Jim vein. These veins are permanently separated, have been so separated for many centuries, and each of them possesses an individuality of its own. The only physical connection that they ever had in past ages was that each of these veins or orebodies at some time in the distant past constituted a part of one main fissure or vein system which was disrupted by the Mallery fault. So far as the testimony in this case shows, it would be impossible for any geologist, either by positive knowledge or through the agency of geological projections to locate the actual physical continuation of the Tom Reed vein. This same condition exists as to the Big Jim vein with reference to the ore which at one time constituted the upward extension of this vein. The Tom Reed or Grey Eagle vein is wholly within the ground of the plaintiff, has its apex within the ground of the plaintiff, and is owned by the plaintiff. The Big Jim vein is wholly within the ground of the defendant, has its apex within the ground of the defendant, and is owned by the defendant. The Sideline vein is partly within the ground of the plaintiff and partly within the ground of the defendant, and a part of its apex is within the ground of the plaintiff, a part is in the ground of the defendant, and a part of its apex is bisected by the common side-line of plaintiff and defendant. This vein is secondary or accidental in character and is of minor importance in comparison with the other two veins in question. As Mr. Hershey very aptly remarked during his testimony, this orebody "lagged behind" when the Mallery fault was formed. A part of this Sideline vein is owned by plaintiff and a part of this vein is the property of the defendant.

That part of the vein which has its apex wholly within the ground of the plaintiff is the property of the plaintiff. That part of the vein which has its apex wholly within the ground of the defendant and where the apex is bisected by the common side-line, is the property of the defendant. The ore beneath the surface of the Big Jim claim cannot be reached by following the Tom Reed vein from its apex in the manner outlined and limited by Section 2322 of the Federal statutes. This section of the Federal statutes is the legal authority and criterion for the exercise of extra-lateral rights. Furthermore, commencing anywhere on the dip of the Big Jim vein, if said vein were extended upward to the surface, the apex of this vein would still be entirely within the surface lines of the Big Jim claim. There are no orebodies within either the Grey Eagle or Bald Eagle claims that may be followed within the manner outlined and limited by Section 2322 of the Federal statutes which would lead into and connect with the orebodies which constitute the Big Jim vein.

Section 2322 of the Federal Revised Statutes is the guiding star in this case. Mines are usually found in mountainous regions, in the lonely places of the earth, where the surface is rough, broken, and irregular, and the veins, lodes, and ledges found beneath the surface are frequently of the same character. The lawmakers who framed Section 2322 in the year 1872 no doubt were aware of this fact, and if they had intended to extend the law of the apex so as to provide for such contingencies as are found in this case, they could have done so, but they did not, and it is not within the province of this Court to change that statute. Under that statute the defendant would be entitled to a judgment in this case even if there had been no horizontal movement when the Mallery fault was formed, but as the Mallery faulting was accompanied by a horizontal movement, there was also created another vital reason why the plaintiff's argument cannot prevail in this case.

Suppose that this Court should adopt the view that this case should be decided from the standpoint of origin, at the time when these veins, lodes, ledges, faults, and apices were formed, would it not be just as reasonable and legal to go beyond the Mallery fault period to other times and other ages and have the geologists read the story of the rocks back to the time of creation? There were no doubt prehistoric times when the premises in question presented very different conditions from those portrayed at the time of the formation of the Mallery fault or immediately preceding that time. Furthermore, if this Court should ignore that horizontal movement and that position should be sustained by higher tribunals, the title to mining property on the hanging-wall side of the Mallery fault would be just as invalid and insecure as the title on the foot-wall side of that fault. In other words, if this case should be decided upon the theory of origin, the plaintiff would not own the Tom Reed vein as found within the Bald Eagle and Grey Eagle claims, but that property might be successfully claimed by some owner of barren ground a few thousand feet away.



LOOKING DOWN SODA BUTTE CREEK TOWARD THE PARK

Cooke City and the New World Mining District

By Lyman H. Brooks Jr.

HISTORY. The New World mining district of Montana is one of the old districts that, after lying dormant for a number of years, is again showing signs of activity. The centre is Cooke City, which is situated in Park county, four miles east of the boundary of the Yellowstone National Park.

The first prospectors came into the country about 1868, but nothing was done until Horn Miller and others arrived in 1871. They first opened up some lead-silver ore on Miller mountain; and in 1877 a small Mexican furnace was built just below Cooke City to treat the lead ores from the Shofly and Street mines. In 1883 this section of country was cut off from the Crow Indian Reservation and was opened for settlement. About this time Major G. O. Eaton bought a group of claims on Republic mountain, built a lead smelter, and started to develop the property. In 1887 the Republic Mining Co. was formed, Major Eaton selling a half-interest to Messrs. Sturges and Lane of Cheyenne, Wyoming. Reuben Rickard became manager, and N. J. Tredinnick, mine superintendent. The company operated the old smelter for eighteen months; as the Republic ores contained much zinc, it was necessary to obtain the clean lead ore from Miller mountain.

Owing to the high freight-rates, the company decided, upon the advice of Rickard, to enlarge the smelter and to build a refinery. He recommended that the lead be held and that the gold and silver bullion only be shipped. However, the necessary funds were not available, so the property was temporarily abandoned.

In 1884 the Morning Star, Bunker Hill, and Black

Warrior claims were opened up on Miller mountain. Lead and silver were the chief metals, although the Black Warrior ore was rich in gold. The ores from these properties went to both the Republic smelter and the little Mexican furnace. In 1887 a Mr. Gassett obtained control of the Black Warrior and Morning Star; he built a small lead-furnace on Miller creek below the Morning Star and did a considerable amount of development work on both properties. The Morning Star was opened up by two adits and a connecting raise. The lower adit is in about 400 ft. There is said to be good ore remaining along the raise from the lower adit to the upper; however, the workings are caved and the existence of the orebodies cannot be proved.

In 1897-98 the Daisy Mining Co. began operations on Henderson mountain. The Daisy claim consisted of approximately ten acres; along the surface a considerable amount of high-grade ore containing free gold was found. The company built a 10-stamp mill on the west side of Henderson mountain and treated a quantity of ore. Later, an adit was driven to cut the orebodies at greater depth, but only sulphide ore was found. The adit is approximately 1500 ft. long; at 1100 ft. it is said that a good body of copper ore was cut. This adit was driven from the west side of the mountain; later two others were started from the east side. They penetrated complex ore of good grade, but no free-milling ore was found. Later the property was taken over by the Western Smelting & Power Company.

In 1904, ore was discovered at Goose Lake; the Copper King Mining, Milling & Development Co. was formed.

Its property consists of four patented claims about ten miles north-east of Cooke City. The company built a road to the property, installed some machinery for sinking, sunk a shaft 60 ft. deep, and did some open-cut work. In 1906 the property was bonded to W. W. McDowell and associates of Butte. Mr. McDowell continued the sinking of the shaft and did some cross-cutting, but dropped the option in 1907. It is said that the grade of the ore continued to be good as development progressed. Mr. Frank Byrne of Cooke City is manager.

In 1905, R. I. McKay took an option on the Republic Mining Co.'s property; the Buffalo-Montana Mines Co. was formed by McKay, Z. W. Davis, and associates. The property was operated intermittently for several years with little or no success, finally going into receivership, McKay becoming receiver. During the summer of 1919, W. D. Marlow took an option on the property, O. V. Miller beginning development work at the mine. He opened up some good orebodies, and in 1920 shipped ten cars of ore. Marlow could not meet his payments, so the property reverted to the old company; Miller left, and McKay attempted to carry on operations, but after a short time he shut-down the mine.

G. B. Allison arrived in Cooke City in 1905. He built a lead smelter and a power-plant and acquired numerous claims but had no success. About this time C. R. Tuttle appeared upon the scene and spent about \$200,000; nothing came of his work either.

Cooke City has been cursed with promoters; a great deal of money has been spent in the past that, if applied intelligently, might have resulted in the opening of several mines, but nothing but old ruins remain.

At present there is only one outlet for Cooke City, through the Yellowstone National Park to Gardiner on the Northern Pacific R. R., a distance of 57 miles. All transportation is by means of motor-trucks, but on the average, one can count on the road being open for only seven or eight months during the year. Two other routes have been proposed, one up Stillwater canyon from Columbus on the Northern Pacific, and the other from Red Lodge and Bear creek by the way of Mount Maurice following Clark's fork, and thence into Cooke City. The latter is an automobile road, a survey of which was made last year. A considerable amount of work was done at the end nearest Red Lodge. It will probably be two or three years before this road is completed into Cooke City.

GEOLOGY. The geology of the district is rather complex and has never been studied in detail. In general the district may be divided into three ore-zones:

(1) The silver-lead-zinc zone of Republic and Woody mountains.

(2) The gold-silver-lead-zinc-copper zone of Miller mountain, and part of the Stillwater country. This zone also contains straight lead-silver ores.

(3) The copper belt of Scotch Bonnet and Henderson mountains and the Goose Lake country.

The Republic and Woody mountains section consists of a series of quartzites, limestones, and shales, resting on a basal granite. These sediments are capped by a dark-

colored rock, probably basalt, and have been intruded by a grano-diorite. The intrusion may be seen on the east side of Republic mountain. No doubt the ores came from the same source as did this igneous intrusion and are related to it.

In the sedimentary series three limestone beds occur: the middle one, locally known as the Republic lime, is about 100 ft. thick, and the only orebodies found occur in it. This limestone is overlain by a bed of shale about 50 ft. thick. About 200 ft. below the Republic limestone is another limestone, and the third limestone occurs at the top of the sedimentary series, directly under the basalt.

The sediments have been much faulted and have a dip of about 10° to the south-west. Two series of faults are noted. The major faults strike N.20°W. and have a vertical displacement of from 80 to 90 ft.; these have



MAP OF MONTANA

been cut later by a series of fissures whose trend is easterly and westerly. Where these faults and fissures appear on the surface in the Republic limestone their presence is noted by black manganese outcrops. Complex silver-lead-zinc ore is found along the fissures at the contact of the limestone and shale.

In the Irma mines the analysis of this ore resulted as follows:

Silver, ounces per ton.....	15 to 30
Lead, per cent.....	10 to 25
Zinc, per cent.....	10 to 30

The zinc occurs mainly as marmatite; very little sphalerite has been seen. Small pockets of high-grade silver-lead ore occur also. Along the fissures the limestone has been changed to quartz; the movement evidently took place after this change occurred, the broken quartz being filled with veinlets of galena. I believe the complex ore to be mainly primary and the lead-silver ore to be secondary. Large bodies of lead-silver ore occur along the major faults in the Republic mine. The lead is chiefly in the form of cerussite and anglesite, although some galena is present. Rich pockets of this ore assayed from \$150 to \$400 per ton. In these oxidized ores no zinc was found. These orebodies are no doubt of secondary en-

richment, the faults and fissures being the avenues of circulation.

On Woody mountain the same conditions are found, the black manganese showing along the faults. No ore has been found, but the old workings do not extend down more than 25 ft. At the base of Woody mountain the Mohawk Mining Co. is sinking on a fault-plane in diorite. The fault-plane is about two feet wide and contains small stringers of galena. Native silver is visible in the specimens, the ore assaying from 150 to 280 ounces.

Miller mountain consists of limestones, shales, and slates much broken by intrusions of andesite and rhyolite whose trend is south-east and north-west. Along the contact the Shofly, Bunker Hill, Bunker Hill No. 2, Morning Star, Iceberg, and Black Warrior claims are situated. A lead-carbonate ore containing silver occurs in conjunction with the complex sulphides; but as the tunnels and shafts of the properties mentioned are all caved nothing can be seen of the underground workings, so it is not known how these ores occur. It is probable that the complex ores are found along the contact of the rhyolite, and that the sediments and the lead-silver ores occur in the limestone. On the south-west slope of Miller mountain, away from the igneous intrusions, all the ores found are clean lead-silver. They occur mainly in limestone.

On the Stillwater the country-rock is granite. The veins strike north-east and south-west. The Samson group of six claims held by N. J. Tredinnick and Harry Stinson of Cooke City have indications of gold, silver, lead, and copper. The U. S. Treasury claim controlled by F. C. Byrne of Cooke City has a vein from one to two feet wide, containing lead and silver with small amounts of copper and zinc.

The gold-silver-copper ores of Scotch Bonnet, Fisher, and Henderson mountains are found in veins in the igneous rocks. No sediments except highly metamorphosed slates are found. The igneous rocks are granite and rhyolite and are, no doubt, tongues from the big granite intrusion which makes the Granite or Saw Tooth range lying to the north and east. The copper occurs in the form of chalcopyrite and bornite, a considerable amount of pyrite being present. Most of the veins strike north and south, and along the mountain tops free gold occurs; the pyrite has been oxidized to limonite and the copper has been leached and carried below. However, I do not believe that secondary enrichment has occurred to any great extent.

The Goose Lake country consists of granite, except for small dikes of dark-colored igneous rock. Throughout this section are found small veins of copper ore, but not enough work has been done on them to ascertain if they continue with depth.

At Goose Lake are the large orebodies of the Copper King Mining, Milling & Development Co. The copper occurs as chalcopyrite in a large pegmatite dike whose width is from 60 to 100 ft. Samples from an open-cut on the Copper King claim are said to assay as follows: gold, \$2; silver, 2 oz.; copper, 9 to 12%; and platinum, from a trace to 1 12 oz. On the Calumet, another of the same

company's claims, an open-cut 40 ft. long gives samples that assay: gold, \$1 to \$2; silver, 1½ oz; copper, 7 to 10%.

OPERATING PROPERTIES. At present there are three properties operating in the district. All are doing development work. The Glengarry Mining Co. is developing the Scotch Bonnet group of claims, on Scotch Bonnet mountain. It has opened an orebody in the pass between Scotch Bonnet and Fisher mountains and at present is driving a tunnel to tap it at depth. The tunnel is in over 800 ft. with considerable distance yet to go. However, it is hoped to cut one or two other veins before the main orebody is reached. It is said the ore assays from \$12 to \$157 per ton, in gold, silver, and copper. F. A. Hancock is manager.

The Mohawk Mining Co. is developing the 20th Century vein at the base of Woody mountain. At present the shaft is down 59 ft.; inside of timbers it measures 6 by 4½ ft. The company has a 25-hp. Fairbanks-Morse kerosene-engine to drive an Ingersoll-Rand compressor. Ingersoll-Rand machines are used. S. G. Forgeron is manager; Lyman H. Brooks Jr. is consulting engineer.

The Irma Mines property joins that of the old Republic on the south. Development work is seen in the driving of a tunnel to cut the major faults of Republic mountain. A small fault was recently cut which yielded some good ore, but the first large fault will not be reached for some time yet. The property has nine claims; the original group consisted of four; later, five others were added.

Last season two companies were working, the Republic, which has already been mentioned, and the Western Smelting & Power Co. The latter has a large number of claims in different parts of the district and has done a considerable amount of work, including the building of a copper smelter four miles above Cooke City and a hydro-electric plant on Clark's fork. Mining operations last season consisted of driving a tunnel on the Gold Dust claim, on the east side of Henderson mountain, to cut the orebodies of the Homestake claim at depth. Operations were suspended last October and at present nothing is being done.

POSSIBILITIES OF DISTRICT. The district contains a variety of ores, and I believe the development work, properly conducted, will produce some good mines. A great deal of money has been squandered in the past by promoters and others ignorant of mining. As a result Cooke City has a black eye. Nevertheless, although the failures in the past have been many, most mining men who have visited the district recently have been favorably impressed by what they have seen. Plenty of opportunities await those who are willing to venture on a promising prospect. Abundant timber is available and power-plants could be built to use the water from a number of streams.

A CANADIAN PATENT has been granted to M. H. Caron, whose process for the treatment of manganese silver ores will be recalled, for the extraction of nickel from silicate ores. By this method the material is subjected to a preparatory reducing roast, cooled under non-oxidizing conditions, and treated by suitable solution methods.

Book Reviews

Intimate Pages of Mexican History. By Edith O'Shaughnessy. Pp. 351. George H. Doran Company, New York. For sale by 'Mining and Scientific Press'. Price, \$3.

The author is the wife of Mr. Nelson O'Shaughnessy, who was attached to the American embassy at Mexico City, first as Secretary of Legation and then as Chargé d'affaires, from 1911 to 1914. Mrs. O'Shaughnessy is a clever and observant woman; she has made the most of her opportunities to study men and events; and while in Mexico she collected a large fund of information, which her literary skill has enabled her to put into attractive form. Five years ago she issued her first book, 'A Diplomat's Wife in Mexico', which was well received, as it deserved to be. It consisted of the letters written by her to her mother and described in a delightfully personal way her own experiences during the turbulent period that followed the enforced resignation of Diaz. The present book is more ambitious; it is a history of Mexico during the last fifty years, the story being told by means of an appreciative description of the careers of the successive Presidents from Diaz to Carranza. With 'El Pomposo' she has no patience; on the other hand, Porfirio Diaz is to her "one of the greatest statesmen and empire-builders of all time". De La Barra, Francisco Madero, and Victoriano Huerta are the other heroes of this story. It is a sad story, for it is written in a vein of sympathy with Mexico and the Mexican people, who have suffered greatly since the day when Diaz was driven out of office by the insurrection instigated by Madero. General Diaz, after making a brilliant military record in the war against the French, became President in 1877 (at the age of 47) and served four years; in 1884 he was again made President, retaining his hold as the Chief of State until he abdicated and went into exile on May 25, 1911, at which time he was 81 years of age. He died in Paris on July 2, 1915.

Mrs. O'Shaughnessy admires Diaz greatly; she draws his picture in warm colors and emphasizes the splendid work he did for Mexico during his long presidency. A man of fine physical presence, "his whole bearing stamped with an indomitable will and an unflinching courage", a soldier and a statesman, was Porfirio Diaz. The keynote of his rule was "Poca politica, mucha administracion". He did not believe in talk; his first task was to "discourage" banditry and give peace to his country by means of martial law. "Knowing the physical and moral conformation of Mexico as no other man has ever known it, the potentialities of his people, the spirit and variety of their national qualities, he proceeded first to give them the essential gift of peace, leaving that of liberty for a more profitable moment." He endeavored to develop the natural resources of the country and to establish new industries. "He proceeded to make it not only safe, but pleasant and profitable, for foreigners to invest their brains and money in Mexico." Under his rule, the railroad system of Mexico came into existence and during his time the mining industry grew into an importance it had not enjoyed since the days of Spanish domination. Before he was expelled from office he had established the credit of Mexico on a firm foundation. In 1910 Mexican bonds were selling at a premium of 5½% on the exchanges of London and Paris, and just before the Madero revolution an arrangement was made for converting the foreign debt to a 4% security. The Diaz administration left 72,000,000 pesos in hard coin for the incoming government of Madero. Mrs. O'Shaughnessy mentions a charming characteristic of Diaz: "His treatment of his inferiors, of servants, was marked by an extreme kindness, and to those of long service he displayed a simple affection, preserving at the same time respect for his position". He loved his people; for he was of them. His father was of Spanish parentage; his mother was half Asturian and half Mixtec; so he was one-quarter Indian.

After Diaz, Madero. It is related that these two met once. Madero is reported to have stated that Mexico was now ready for a democracy and that it was time for Diaz to relinquish his power into the hands of an honest man—himself. "Señor," said Diaz, "a man must be more than honest to govern Mexico." That will serve for Madero's epitaph. He was honest, but a fool in government. "Had he been a bad man, but a clever one, with his feet on the earth and some knowledge of statecraft, according to Machiavelli, the history of Mexico would have been different. His very virtues, so multiple, so apparent, so confounding even, meant her ruin and his own, and that incompetent, short, squarish hand of his, so freely used in gesture, was the predestined instrument of catastrophe." Madero was elected by popular clamor, not by the ballot. The French Secretary of Legation believed in "la démocratie intégrale"; "he was unmoved", says Mrs. O'Shaughnessy, "by jokes concerning the famous unopened sacks of votes we had seen at the Chamber of Deputies that morning, in the Protocol office—corded, sealed, bearing naively the evidence of their origin, 'Colegio Electoral de Torreón', 'de Guadalajara', 'de Chihuahua', etc., whose numbers were to forever remain a secret. He did allow, with an unavoidable smile, that it would have been wiser to remove the bales, or at least their tickets, from the cold foreign eye". Again: "Of Madero's initial sincerity no one has ever raised a doubt. His honesty was apparent to every one who approached him; his lack of preparation for government was proven immediately he came to power." He was "rash in all his promises, indiscreet in all he said, vacillating in all his acts and passionately unreflecting in all his judgments. On the face of it, had the nation been sane, it would have been known that he was not the man to govern Mexico." But the Mexican nation was not sane; it was drunk with dreams, and hypnotized by a visionary; it was bemused by words such as 'Liberty', 'Reform', 'Justice', and 'Independence'. "These words are known to every Indian equally with 'siesta' and 'maíz'. Of their origin and attributes he has no clearer idea than we of the great First Cause. Doubtless when his corn has been trampled by soldiers in the name of 'Independencia', his wife (or wives) and daughters outraged in the name of 'Libertad', his land taken from him in the name of 'Reforma', and he himself is up against a wall looking with deer-like eyes into the muzzle of a gun in the name of 'Justicia', he has a vague though necessarily brief and profitless perception of their meaning." Madero, in Mrs. O'Shaughnessy's opinion—and that of many others—was purely destructive; he did nothing to upbuild; his sentimental anarchism simply destroyed the political structure that had become enfeebled as Diaz grew old. Madero's agrarian reforms were frustrated by his unscrupulous followers. He mistook his early popularity for national prosperity. He was a Mexican Pied Piper and he led his people into the abyss. "To the very edge he preserved his illusions." The Madero family is said to have numbered 232, and a horde of them obtained office. Of these, his uncle, Ernesto Madero, was made Secretary of the Treasury. Another was his brother Gustavo, a cynical profiteer, who remarked that "of a family of clever men the only fool was President". Madero did not know how to punish, neither did he know how to reward. This was a fatal defect in a country such as Mexico where men stand or fall upon the strength of their personal following. He had frustrated the 'científicos'; he had thwarted the reactionaries; he had intimidated the holders of property; he had aroused the malicious wit of the press. Meanwhile he failed to make good his promises to the people; he was frustrated in his dream of reforming the institution of Mexico, and became open to attack by insurrection. On June 7, 1911, he had become President; in the March following, his military genius, Pascual Orozco, announced that "he would shortly be in Mexico City and would hang Madero to the largest tree in

the Plaza Mayor". In October 1912 Felix Diaz, the nephew of the ex President, started a revolt at Vera Cruz. Early in February 1913 the City of Mexico was in full revolution under the leadership of Felix Diaz and General Reyes. The Government forces were under the command of General Huerta. On February 15 the Senate passed a resolution demanding the resignation of President Madero and the Vice-President, Pino Suarez. Three days later Madero and Suarez surrendered and were incarcerated in the Palacio Nacional. Huerta assumed the executive power. In the night of February 22, 1913, Madero and Juarez were killed under circumstances never clearly disclosed. Then Mexico went from bad to worse. The United States refused to recognize Huerta as President and his authority thereby was gradually undermined.

The sympathies of the author are with Huerta and his people. The 'esprit militaire' of the Mexican president was entirely opposed to the 'esprit universitaire' of President Wilson. They could not understand each other. The manner of Huerta's accession to power was technically "according to the Mexican constitution, by which it must be judged", she says. "There are no doubts about its completed legality." Thus: "Madero's resignation, given three days before his death, was accepted by Lascurain, the Minister for Foreign Affairs, who became President 'ipso facto'. Lascurain appointed Huerta Minister of the Interior, and then himself resigned, whereupon the executive power passed legally into Huerta's hands. It was all according to Hoyle—in this case the Constitution of the country. President Wilson judged Huerta by the standards of the United States and refused to recognize him. Meanwhile Mr. Wilson thought that Villa "was perhaps the safest man to tie to" and Mr. Bryan pronounced that bloody ruffian an "idealist". These notions led naturally to the lifting of the embargo on the exportation of arms and ammunition from the United States into Mexico and the consequent arming of Huerta's enemies. That was on February 3, 1914. In the following April came the Tampico affair, which led to the capture of Vera Cruz by American marines. Mr. Josephus Daniels has explained that the Tampico affair was different from all other insults to our flag, notably those offered by Carranza, "in that then the purpose was to force Huerta out of Mexico". It succeeded. The old Indian was beaten. He fled from the country. In July 1915 he was arrested when about to re-enter Mexico to start a revolution. On January 13, 1916, he died at El Paso. The author quotes Mr. Dooley's description of conditions in Mexico, and it is intensely funny, but to quote it here would mar the sentiment of the book, which is sad, simply because it is sympathetic to the misfortunes of the Mexican people. It is good book for all of us to read because it gives us the point of view of the Mexicans, who, after all, are most to be considered in any adjustment of their own domestic affairs.

Mrs. O'Shaughnessy says of the Huerta tragedy: "He was an Indian from the State of Jalisco, in control of the supreme power, and he acted with his usual fidelity to type. To demand of him that he be something that he was not, of Mexico something that she is not, was quite simply to invite the most evitable political disaster of modern history." He said of Wilson: "He has not understood." Neither did Huerta understand the apostle of 'The New Freedom'. We commend the book to those desiring to understand Mexico and to those looking for intellectual pleasure in reading. T. A. R.

Cams, Elementary and Advanced. By Franklin DeRonde Furman. 229 pp., ill., index. John Wiley & Sons, Inc., New York. For sale by 'Mining and Scientific Press'. Price, \$3.

This is an enlargement of the author's book on 'Elementary Cams', first published five years ago. The principal features of the earlier book were a classification and development of methods of solution of problems relating to

the most commonly used cams, together with a series of factors for base-curves in common use. The additional matter in the present volume relates mainly to the development and use of more complicated base-curves, together with comparisons of the characteristic results obtained from all base-curves. The theory developed in the text is illustrated by a number of practical problems. The book will be of service to the student of machine design and to the practical designer of machinery.

Foundry Molding Machines and Pattern Equipment. Second edition. By Edwin S. Carman. 220 pp., ill., index. Published by the author. For sale by 'Mining and Scientific Press'. Price, \$5.

The author of this book, who was recently elected president of the American Society of Mechanical Engineers, has had a large part in the development of molding machines in general, and has designed several machines himself. Consequently, he is better fitted for the task of authorship than is usually the case with the writer of a book describing mechanical devices. For not only does he thoroughly understand both the principles and the machines he is discussing, but he also realizes that most of his readers do not have any such understanding, and has therefore endeavored (successfully, we think) to explain these principles and machines so clearly that anyone in the least acquainted with foundry work can follow his treatment of the subject. The first two chapters discuss various elementary principles of molding and also the theory underlying jolt-ramming. Then come three chapters on roll-over jolt machines, segregated according to the size of the mold desired. The application of jolt machines to brass and aluminum foundries is then discussed. Then comes a chapter devoted to the plain jolt machine, following which are chapters on air-operated squeezer machines and on jolt-stripper machines. Pattern equipment, flask equipment, and machine-molded cores are next discussed, in the order named. The final chapter is devoted to the design of foundations for jolt machines. The discussion in the text is supplemented by more than 200 illustrations. The book should be in the hands of every foundryman.

Introduction to the Principles of Physical Chemistry. By Edward W. Washburn. 516 pp., ill., index. McGraw-Hill Book Co., Inc., New York. For sale by 'Mining and Scientific Press'. Price, \$4.

The original purpose of the author of this book was to present the principles of modern physical chemistry in the form of a systematic course of instruction and training. Although designed primarily for the use of classes composed of students who purpose to become professional chemists or physicists, it will serve as a suitable foundation course for any class of students who wish to obtain a usable knowledge of the subject. The book is complete, much new material having been added to bring the present edition up to date; it is well written and well edited. The author has introduced an interesting modification by supplementing the names of authorities quoted with informative footnote references of interest.

Mechanical World Electrical Pocket Book for 1921. 306 pp., ill., index. Emmott & Co., Ltd., Manchester, England. Price, 2 shillings.

The principal changes made in this useful pocket-book since the 1920 edition was published, include revision of the divisions dealing with motor-starters, transmission-cables, wiring systems, electric heating and cooking, and electric elevators. In general, it may be said that the book, while naturally not so complete as the more expensive pocket-books, nevertheless gives a great deal for the money.



GOLD RELIEF BILL NOW BEFORE CONGRESS

Fletcher Hamilton, State Mineralogist of California, is in receipt of a communication from Congressman Louis T. McFadden regarding the new Gold Relief Bill introduced on April 25 as H. R. 5025 in order to conserve the gold-ore resources of the nation, which are being wasted through the continued shutting-down of the gold mines. Mr. McFadden says: "The bill provides revenue from an excise of 50c. per pennyweight of fine gold contained in manufactured articles, to be collected at the time of sale, and for a premium of 50c. per pennyweight to be paid to the producers of newly-mined gold in the United States and its possessions. The Government is fully protected under the provisions of the Bill from the presentation of other than newly-mined gold to receive the premium. The bill differs from H. R. 13201, introduced by me in the last Congress, in that the period has been lessened from five to three years, and that the Secretary of the Treasury is granted full authority to terminate entirely the provisions of the Act on three months notice in the event of a return to normal economic conditions prior to the expiration of the same. Exporters of articles containing gold have been exempted, as they were from the payment of the luxury tax, in order not to interfere with foreign competition. Revenue will be derived on all gold articles of foreign manufacture sold in this country. The industrial consumers of gold have been receiving gold at the pre-war price. They will continue to receive bullion from the Mint at the monetary price of \$20.67 per ounce, but through the payment of the excise when the manufactured article is sold they will be paying more nearly the production cost of gold and thereby lessen the subsidy which in effect they now enjoy. The premium to the producer of new gold is a compensation for the increased cost of production and cannot be construed as a subsidy. The Bill provides an equitable adjustment between the producer and the industrial consumer of gold. Extensive hearings were conducted in the last Congress on this Bill and it was reported favorably by the sub-committee of the Ways and Means Committee before adjournment. Increases in freight and power-rates have more than offset any decline in wages and materials consumed in gold mining. Because of the emergency confronting the gold-mining industry, the enactment of this Bill should be expedited."

SPRING MEETING OF THE A. S. M. E. AT CHICAGO

Industrial Chicago has many things to show mechanical engineers attending the spring meeting of the A. S. M. E. on May 23 to 26. The places which offer to entertain guests in this way are too numerous to be seen by all within the four days of the meeting, so several are scheduled for each day, so arranged, as far as possible, that the individual may suit his taste by selection daily without feeling that he is missing something he would like to see. Among the opportunities offered are: Tuesday: Sears, Roebuck & Co., handling and shipping merchandise; Mandel Brothers, package handling, coal and ash handling, connection to sub-street tunnel system; Western Electric Co., manufacture of telephone apparatus and cable for the Bell Telephone system. Wednesday: Illinois Steel Co., South Works, South Chicago,

plate-mill, rail-mill, bessemer converters, and general steel-mill equipment; Commonwealth Edison Co., modern turbine central station at Fisk street; Pennsylvania Lines terminal, freight-handling plant, in connection with which there may be visited the neighboring warehouse of Marshall Field & Co. and the U. S. Terminal building; Crane Company, manufacture of valves and fittings in cast iron, malleable iron, steel, and brass, the fabrication of pipe work. Thursday: Chicago Mill & Lumber Co., 120-in. paper-machine, manufacture of fibre, corrugated board, and paper boxes; Pullman Company, Pullman cars, passenger coaches, and freight cars; Underwriters' Laboratories, testing of appliances and devices for fire prevention. Friday: Milwaukee Railway & Light Co.'s Lakeside plant, trip by rail to Milwaukee, boilers fired with powdered coal.

COPPER SHARES SHOW DECIDED IMPROVEMENT

The attached table indicates a decided buoyancy in shares of the copper-producing companies. The low quotation for 1920 was recorded in November or December of that year. The last column indicates the advance in present quotations over the 1920 low.

	—1921—		1920 Low	Close May 3	Advance
	High	Low			
A. S. & R.	44 $\frac{3}{4}$	34 $\frac{3}{4}$	29 $\frac{1}{4}$	43	13 $\frac{3}{4}$
Anaconda	42 $\frac{3}{4}$	33 $\frac{3}{4}$	30	41 $\frac{3}{4}$	11 $\frac{3}{4}$
Cerro de Pasco....	32 $\frac{3}{4}$	23	24 $\frac{1}{4}$	29 $\frac{1}{4}$	5
Chile Copper	12 $\frac{1}{4}$	9	7	12 $\frac{1}{4}$	5 $\frac{1}{4}$
Chino	25 $\frac{1}{4}$	19 $\frac{1}{4}$	16 $\frac{3}{4}$	25	8 $\frac{3}{4}$
Greene-Cananea ..	25 $\frac{1}{4}$	20	15	25 $\frac{3}{4}$	10 $\frac{3}{4}$
Inspiration	37 $\frac{1}{4}$	29 $\frac{3}{4}$	28	36 $\frac{1}{4}$	8 $\frac{1}{4}$
Kennecott	21 $\frac{1}{4}$	16	14 $\frac{3}{4}$	21	6 $\frac{3}{4}$
Miami	24	15 $\frac{3}{4}$	14 $\frac{1}{4}$	23	8 $\frac{3}{4}$
Nevada	12 $\frac{1}{4}$	9	8	12	4
Ray Con.	14 $\frac{3}{4}$	11	10	14 $\frac{1}{4}$	4 $\frac{1}{4}$
Seneca	20 $\frac{3}{4}$	12 $\frac{3}{4}$	14 $\frac{1}{4}$	16 $\frac{1}{4}$	2 $\frac{1}{4}$
U. S. Smelting....	35 $\frac{1}{4}$	26	29 $\frac{1}{4}$	33 $\frac{3}{4}$	4 $\frac{1}{4}$
Utah Copper	59 $\frac{1}{4}$	45 $\frac{3}{4}$	44 $\frac{1}{4}$	54 $\frac{3}{4}$	10 $\frac{3}{4}$

D. C. JACKLING ON THE COPPER INDUSTRY

A non-committal attitude with respect to the copper industry is taken by D. C. Jackling, who arrived in San Francisco from New York on May 9. Nevertheless, Mr. Jackling believes that the huge copper surplus is slowly, but gradually, being reduced, and that this reduction will become more noticeable as soon as present stocks at the refineries are cleaned up. He feels that one reason for optimism is the indication that European nations are nearing some sort of an agreement. The controlling factor in the copper situation, he said, is the foreign demand. On the other hand, from the standpoint of the producer, Mr. Jackling is pessimistic, as each day's shut-down is costing the copper companies dearly. When asked as to how soon the companies under his management were likely to resume operations, Mr. Jackling was unwilling to hazard a guess other than to say it would not be before 1922. He stated that the Utah Copper Co. undoubtedly will build a 40,000-kw. power-plant at Magna if the present rates on electric power imposed by the State Public Utilities Commission are permitted to re-

main in force. He stated that it was the policy of his organization never to duplicate facilities where an efficient service could be obtained at an equitable rate, and considering the large amount of power required, with the long assured life of the Utah Copper property, necessarily some time would be required to arrive at a definite decision as to the course the company will pursue in the power matter. On May 1 the Utah Copper Co. laid off about 160 men, and the total force on the payroll now numbers about 150.

A. S. & R. CO. PASSES DIVIDEND ON COMMON STOCK

The American Smelting & Refining Co. has passed its regular quarterly dividend of 1% on the common stock. The regular quarterly dividend of 1½% was declared on the preferred stock. This is the first time since 1904 that the company has passed its common-stock dividend. The company issued the following statement in reference to the passing of the common dividend. "Owing to the low price of metals prevailing, many mines have closed down, and those still running are operating on a greatly reduced capacity. Copper, zinc, and tin are still below pre-war levels and lead was until the present week. Costs of production, especially transportation, are considerably above the pre-war period. In March we smelted only about 25% of the tonnage per day of lead ore that we did in the last quarter of 1920. All of our zinc smelters are closed, excepting only the zinc-oxide operations at Blend."

ALASKA

Juneau.—It is officially announced that the Alaska Gold Mines Co. will discontinue mining and milling operations on June 1. Negotiations are under way looking to the conversion of the company's hydro-electric power plants for use in the manufacture of paper from wood-pulp. Mine and mill equipment will be sold.

Kennecott.—Stephen Birch, president of Kennecott Copper Co., at the annual meeting of stockholders stated that the Mother Lode Copper Mines Co., a subsidiary of the Kennecott, on May 2 paid off its entire indebtedness amounting to \$1,000,000 in 5% notes. Mr. Birch in answer to a question by one of the stockholders, as to when dividends would be resumed by Kennecott, stated that no one could accurately make a prediction in this connection. He pointed out that the Braden Copper Mines in Chile has expended thus far about \$30,000,000 in improving its property which, according to geological experts, has an estimated ore-life of about 70 years. When these improvements are completed, at about the close of the present year, the various properties of Kennecott will have a capacity for production largely in excess of 200,000,000 lb. of copper per year. The Braden mines at present are operating on a restricted basis as also are the mines in Alaska.

ARIZONA

Globe.—More than 300 Mexican employees with their baggage have been taken to Nogales, Sonora, at the expense of the Inspiration Copper Co. and Gila county. The Inspiration company has agreed to transport all Mexicans who were in its employ on January 1 of this year.—Miami Copper Co.'s cost of producing copper last year was 11.898c. per pound, including estimated Federal taxes, renewals, and repairs. Deliveries of refined copper totaled 57,563,038 lb. at 18.68c. per pound. The report says production of refined copper was 57,531,328 lb. from treatment of 1,801,958 tons of ore. Development in the lower part of the main orebody was extensive and resulted in adding about 1,500,000 tons to the previous estimate with a slight lowering of the grade. Ore-reserves as of January 1, 1921, were 10,723,419 tons of 2.26% copper, 36,000,000 tons of 1% copper, 6,000,000 tons of 2% copper.

Jerome. At a special meeting of stockholders of the Jerome Verde Copper Co., held at Phoenix on May 6, the sale of a substantial interest to the United Verde Extension Co. was authorized. The name of the new company will be the Jerome Verde Development Co. The United Verde Extension will develop the newly acquired property through its deep workings to good advantage.

Kingman. Several mining properties are already being developed in the recently established camp of Katherine, in the Union Pass country about 35 miles from Kingman.

At the Gold Chain property a hoist and compressor have been installed. A two-compartment shaft is now being sunk at a point 125 ft. below the tunnel-level to tap, on its dip, the vein exposed at surface. A recent sampling of wide sections of the outcrop gave an assay return of from \$5 to \$10 gold and from 2 to 15 oz. silver per ton. Development work is in direct charge of F. C. Nourse.—Shaft work is under way at the Katherine Extension mine and is being expedited by the hoisting and compressor plants that were recently installed. The area lies between the Gold Chain and Katherine estates and is on the strike of the Katherine fissure. At 200 ft. the continuation of the Katherine vein is expected.

In the Katherine mine many of the headings and crosscuts on the four levels and in the raises between them are in ore. The tonnage at present blocked-out has an estimated value well in excess of \$300,000. At a recent meeting of the Katherine stockholders in Kingman, plans were made to finance a small mill for the reduction of the Katherine ore. It is planned to sink the shaft from the 400-ft. level to a depth of 700 feet.

A. G. Cushman, of San Francisco, and Mlle Wash, of Oatman, have taken over a group of claims in the vicinity of the Katherine mine and are now erecting the buildings preliminary to development work. Similar work is also being done on the Katherine-Mohawk group of claims, recently purchased by Frank T. Torpey and other San Francisco mining men. Operations will be in charge of Albert Degenhart.

At the Oatman-Revenue property, shaft work is well advanced. Henry Johnson, formerly of Chihuahua, Mexico, is in charge.—At the Roadside mine, recently optioned to Thad M. Boggs, metallurgist, and Sherman Bagg, plans are being made for development work.

Yuma County.—The property of the New La Paz Gold Mining Co. is in Yuma county, Arizona, about 12 miles north-east of the town of Blythe, California. It comprises 15 claims, lying in Goodman Arroyo, covering an area of 1596 acres. This ground was the scene of a gold rush in 1862 and was extensively worked for the following six years by dry panning. Later dry-washing machines were introduced and work was carried on in this way until this land was taken into the Colorado River Indian Reservation, from which it has only recently been released. The east end of the property was systematically prospected and sampled by E. A. Razor in 1916. The prospecting was done by means of pits, some 74 being sunk on this portion of the property. Thirty-three samples, varying in weight from 80 to 180 lb., were run through a dry-washer and the concentrates panned. The material from the pans then dried and the coarse gold separated out and weighed. The black-sand concentrates, from which the coarse gold had been removed, were then combined and assayed. The combined value is reported as averaging \$2.50 per cubic yard. The placers are to be operated by hydraulic-mining methods; 125 miners inches of water will be pumped from wells at the old town of La Paz on the banks of the Colorado river, 4½ miles east of the point of operation. The water from the tailing will be impounded and used over again, being pumped through an auxiliary plant. In operation, the water

pumped from the La Paz wells will be used as make-up water to supply the losses. The capacity of the plant is expected to be 1500 cu. yd. per day at a cost of 45c. per cubic yard of gravel mined. The accompanying illustration shows the work on the 12-in. main, which will carry the water to the reservoir 225 ft. above the gravel deposits. O. L. Grimsley is general manager.

CALIFORNIA

Altaville.—Work of straightening and timbering the shaft at the Toll Gate mine is progressing; machinery is being installed. The shaft is to be taken down to the 200-ft. level. The ore on the 100-ft. level was cross-cut 23 ft. with no wall in sight. The mine is equipped with a two-stamp mill, plates, and concentrator.—The Triple Lode mine is situated about three-quarters of a mile west of the lode proper in a 'sulphide' area of some promise. The workings on the 250-ft. level have disclosed a number of bodies of heavy sulphide. The ore differs considerably from the ore of the lode, but it may be amenable to cyanide and therefore more cheaply treated than the lode ores. No mining is being done, but the water is being kept out, pending financing.

Calaveras County.—A rich find was reported recently in the Washington mine. The mine is one of the oldest in Calaveras county, and is near the old Calaveras mine. Workings consist of numerous shallow tunnels and shafts, said to have produced about \$300,000 years ago. Recently ore was found near the end of a 700-ft. drift, and a short stope 15 ft. high and 20 ft. long yielded \$1200 on the plates and about \$500 in concentrate. The plant consists of five 850-lb. stamps, a battery built in 1873, plates, and one of the first Wilfley tables used in California.

At the Morgan mine 30 stamps are being operated, having a capacity of 15,000 tons per month. A cross-cut in the lower levels has opened up another rich shoot in the hanging-wall country. Reserves of some \$5,000,000 are reported in the mine.—The ten-stamp mill at the Finnegan mine is ready for operation. A raise was made from the 600-ft. level to the surface for the purpose of handling the ore; it is not yet timbered or equipped for hoisting. For the present the mill will handle the ore on the dump, which will be hoisted to the mill on a tram. Ultimately the mill will be equipped with stamps, classifiers, a Hardinge mill for re-grinding, plates, and concentrators. The tailing will be impounded for later treatment by cyanide.—Twenty stamps are now dropping in the mill of the Angels Camp Deep company. The grade of ore milled is being slowly bettered, and the development work both on the 500 and the 200-ft. level is being pushed.

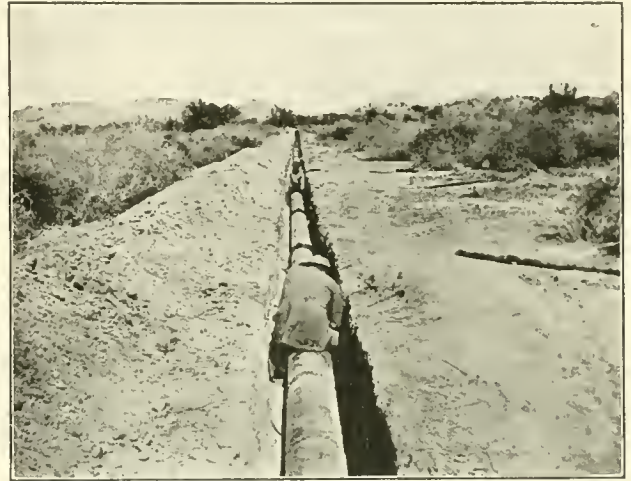
Grass Valley.—Approximately a thousand miners are employed in the mines of the district. Of these 450 are engaged at the Empire-Pennsylvania group, 250 at the North Star, 100 at the Idaho-Maryland, 25 at the Sultana, 25 at the Allison Ranch, and the remainder in various small properties of the district. The wage agreement between the operators and the Mine Workers Protective League expires July 1. It is reported that the company will endeavor to establish a lower scale on the ground that the cost of living has decreased.

Jackson.—The Moore Mining Co. has purchased new equipment and will re-open its mine one mile south of here. Horace G. Perry is manager.

Redding.—Plans and specifications for an aerial tramway 18,329 ft. long, have been completed by the Mountain Copper Co. operating the Hornet mine at Keswick. The tramline is designed to deliver ore direct from the mine to the loading platform of the Southern Pacific Co., and is scheduled to go into service about November 1. The company has developed a large tonnage of pyritic ore in the Hornet property, and is shipping the product to plants on San Fran-

cisco bay for conversion into chemicals and fertilizers. The Hornet also contains deposits of low-grade copper ore, but this material will be held in reserve until the copper market warrants production.

Lawrence Gardella of Croville, who has operated two gold dredges on Clear Creek, three miles below here, for several years, has contracted to pay the American Gold Dredging Co. \$75,000 for 310 acres of pasture land lying directly west of his own holdings. Gardella's dredges have worked up to the west line of his ground. Now that the deal has been made for the land further up the creek, his No. 1



New Pipe-Line of the La Paz Mining Co.

dredge will go into the new field, which has been thoroughly prospected. According to the agreement Gardella is to pay for the land at the rate of \$3000 per month.

COLORADO

Blackhawk.—The Silver Mountain Mining Co., drifting at 260 ft. in its main shaft in Silver gulch, is mining high-grade ore, a recent assay showing 157 oz. silver. One lot is ready for shipment to the smelter. The Midwest Mining & Milling Co. is mining ore assaying 100 to 300 oz. silver per ton on its Cyclops group.—The Gilpin Eureka will shortly resume shipments of gold ore.

Breckenridge.—The Wellington Mines Co. continues development and is adding to reserves, but will not resume treatment at its two concentrating plants until there is definite improvement in prices for zinc.—The Royal Tiger Mines Co. is nearing a depth of 300 ft. in the winze below the tunnel-level, a total depth from surface of 1000 ft. The Mineral Hill holdings of the company are to be further developed this season.—The new dredge of the Blue Valley Placer Co. is nearing the rich channel in the B. & L. placer in the Blue River valley, 2½ miles north of Breckenridge. Coarse gold has already been found in recent clean-ups.—The Tonopah Placers Co. is operating its No. 1 dredge; the old No. 2 and No. 3 boats are to be dismantled.

Cripple Creek.—The Moonlight Gold Mining Co. has re-timbered the Rittenhouse shaft, on Gold hill, to the 400-ft. level and resumed operations at the first and fourth levels, where a good grade of mill-ore is exposed.—Owen Roberts, lessee of the El Paso Gold King, the first regular producer at Cripple Creek, is again shipping. A car of mill-grade ore has been consigned to the Golden Cycle mill at Colorado Springs. The same operator is also making a success of his lease on the Strong mine at Victor. Both properties are controlled by the Lennox-Giddings interests of Colorado Springs.

The Vindicator Consolidated G. M. Co., in a letter to stockholders, advises that an option has been taken on

properties in Pinal county, Arizona. The lease and bond covers 300 acres traversed by several quartz veins, the outcrops of which show free-milling gold ore with low silver content. Recent development work at depth in the Tripplie Creek mines has been encouraging.

Kokomo.—A second unit is being added to the Wildley mill in the Ten Mile district and the plant will shortly be treating close to 100 tons of ore from the Wildley group, where a four-foot vein of sulphide ore containing 15% lead and some gold, silver, and zinc is under development. The mill and mines are operated by C. L. Wilson, of Leadville, and associates. The Terry 'selective flotation' process is in use at the mill and is making a close saving, according to reports.—The Michigan mine near the Wildley group is also operated by Leadville men and is shipping daily 25 tons of ore with high sulphur content consigned to a chemical works at Denver, and some smelting ore to the Arkansas Valley plant at Leadville.

Ouray.—The Gold Crown mill will handle custom ores as soon as the roads are open; the plant is now being overhauled.—The Lucky 20 Mining Co. is making ready to resume operations on its Iron-ton Park properties.

Silverton.—The Dives, Gold King, Shenandoah, Trilby, and other San Juan mine properties are making ready to resume production as soon as the Silverton Northern railway resumes rail service. The properties named ship to the Durango smelter. The Erma Leasing Co., operating the Silver Lake property, has a large tonnage of mill-ore ready for shipment to the Iowa-Tiger mill, and several carloads of high-grade ore awaiting shipment to the Durango smelter.

The Sunnyside M. & M. Co. shut-down its lead and zinc mines near Eureka, on May 1, awaiting increased prices for these metals. The mill is of 500-ton capacity and both mines and mill employed between 500 and 700 men. The Sunnyside mine is the largest producer of the San Juan.—Development is in progress at the Toltec mine of the U. S. Mining Corporation, on an orebody 40 ft. wide of complex gold-silver-lead-copper ore. The work is at a depth of 1400 feet.

Telluride.—The Matterhorn M. & M. Co. is mining good ore from the recently acquired Butterfly-Terrible property.—The new mill of the Valley View Leasing Co. on the San Bernardo property is operating continuously and producing two carloads of concentrate weekly.—Production from the Black Bear and Smuggler Union properties has been curtailed pending the early completion of the new Smuggler Union flotation plant.

IDAHO

Coeur d'Alene.—Machine-drills are in operation on the Lookout Mountain mine on Pine creek. Installation of power equipment was completed recently and active development work started. The drills are in use in the lower cross-cut tunnel, which has been extended 435 ft. toward the vein on the 300-ft. level. In the upper workings the Lookout vein disclosed a strong showing of lead-silver ore, in carbonate form, across a 25-ft. width, and to reach this at greater depth the present tunnel was started.

The Alhambra concentrator on Elk creek is to have its capacity increased to handle 100 tons of ore daily. The entire plant will be remodeled and the work will be completed about June 1, according to Stanly A. Easton, president. Jigs, rolls, and classifiers will be added to the flotation machines now in use. The tube-mill is being re-lined. These improvements were necessitated by the recent discovery of lead-silver ore on the Crescent group. About 14 men are employed in development work on the Alhambra and Crescent properties.

A two-cent dividend, payable June 20 to shareholders of record on June 10, was declared by the newly elected trus-

tees of the Marsh Consolidated Mines Co. recently. This will amount to approximately \$40,000 and will leave in the neighborhood of \$50,000 in the company treasury for development work.—It is reported that lessees at the Hunter mine are finding large pockets of high-grade silver ore in the old workings of the mine. Several carloads have been shipped from these leases with satisfactory results.

Halley.—The Bunker Hill & Sullivan company has acquired the Mayflower-Bullion mine, consisting of six claims, situated seven miles from here, and will commence operations within a short time. The Mayflower mine was originally owned by Col. E. A. Wall, of Salt Lake City, and the Bullion property was among the holdings of the Wood River Gold & Silver Mining Co. The two properties were operated in 1881, and since that time have produced over 12,000 tons of lead-silver ore with a gross value of \$2,000,000. Material and equipment have been shipped to the property. At present the Wood River Power Co. is building a power-line from Halley to the Mayflower-Bullion, seven miles. The ore from the property will be shipped to Kellogg for treatment at the Bunker Hill smelter.

Leonida.—The plan of placer-mining at the Gold & Ruby property is unusual, according to Stewart Campbell, State Mine Inspector for Idaho. A method of separating black and gray sands has been developed, and if the new concentrating plant works as successfully on a large scale as it does in the working model, it will be a new step in placer-mining practice. It is planned to save lead, copper, and other minerals, including garnets, misclassified rubies, as well as gold.

MICHIGAN

Houghton.—The first shipment of copper by boat for the season left Houghton the last week in April. It consisted of 300,000 lb. of Calumet & Hecla copper, loaded at the company's smelter at Hubbell, for domestic consumers in the East. Within a few days 1,200,000 lb. of Calumet & Hecla copper for Germany will leave here by boat. On May 15 a similar shipment will go forward, which will clean up all German business at present on the books, amounting to a total of 4,000,000 lb. The company continues to sell considerable copper for domestic use. An order for 800,000 lb., for an Illinois customer, has just been filled. Domestic consumers are evincing more interest in the market, apparently realizing that the days of cheap copper are numbered. The Quincy Mining Co. has had a good customer in the Dollar Bay wire mill in this district, which has taken as high as a million pounds of Quincy copper per month. Quincy now is working only one furnace, part capacity, so recent sales have helped reduce the company's metal surplus.

Mohawk and Wolverine wages are back on a pre-war basis, but all other costs continue abnormally high. There has been no decrease in freight-rates, which add greatly to the expense of transporting ore and coal; coal is more than 100% higher than before the War, costing \$7.50 per ton here in cars, as compared with the previous price of \$3; powder is still high, and drill-steel is only 2c. per pound cheaper than the highest price paid during the War.

But little timbering is being done in the Calumet & Hecla shafts. Some timbering is necessary in the Red Jacket shaft, which is in use a part of each day. No. 5 shaft, Tamarack, also is being kept in repair, for this shaft is used for bailing purposes. No. 3, Tamarack, is in commission for pumping. Four machines are being used in development work on the Kearsarge lode, encountered in the east cross-cut from the 81st level of the Red Jacket shaft, and the 'rock' taken out is being brought to the haulage way and hoisted to surface.

The Victoria mine in Ontonagon county has shut-down to await a more favorable turn in the metal market. Only 70 men have been employed of late, and in the last few weeks

they have been engaged in cleaning the stopes of ore accumulated in mining operations. Victoria closed the year 1920 with a surplus of 1,180,955 lb. of copper, valued in the annual report at \$162,544 or better than 13½c. per pound.

Ground on a par with that in the other levels is being opened in the new drifts on the 6th level of the Seneca property. Drifting north is under way on the 3rd and 5th levels. All of these openings are in ground of good quality. Stopping is still being done on the 4th level and the character of the 'rock' being opened is encouraging. Drifting on this level has been stopped temporarily until stoping is completed. Seneca has made another slight reduction in wages.

MONTANA

Basin.—Two feet of high-grade silver ore has been opened in the Obelisk mine near here, according to reports reaching Butte. A sample of the ore taken across a width of 26 in. assayed 92 oz. in silver and 10% lead. The ore was struck in a raise from the 200 east drift below the tunnel-level.

Butte.—The Butte & Superior company's No. 3 shaft has reached a point within 50 ft. of the 2700-ft. level. The objective is 3000 ft. The shaft is in the south branch of the Rainbow lode; samples range from 10 to 25% zinc and from 5 to 12 oz. silver. It is reported that a drift on the 2050-ft. level disclosed 12 ft. of medium-grade chalcopryite ore. If the facts are as stated, this is the first deposit of copper ore of any consequence yet discovered in the mine.

Dillon.—According to Henry Auerbach, president of the Silver Spring Mining Co., whose property is 21 miles south of here, a large tonnage of 5% lead ore has been developed. L. D. Lyons is in charge of the property. A 100-ton mill may be built.

Elkhorn.—A report states that ore assaying 1200 oz. silver per ton has been uncovered in the Union mine.

Helena.—Rich ore near the surface is being mined from the Willard mine in the Warm Springs district by the Jefferson & Teton Mining Co.

Libby.—William Criderman, William Cady, and Joe Sheffield are developing a group of claims on Libby creek 23 miles from here. They believe that they have the vein from which the gold in the productive Libby Creek placers was derived.

Lump Gulch.—A shaft is being sunk on the Pay Back property, where some excellent ore has been found on the surface.

Neihart.—Installation of new machinery at the Hartley property marks a new era for that concern. The company is employing 65 men. Work is to be started at once in the shaft, which will be sunk an additional 100 ft. to the 400-ft. level. With the output from the new level, the Hartley will ship at least 15 carloads per month.—Liscomh and Parmenter are leasing in the Florence from which they make regular shipments.—Walker and Fredson are working the Queen of the Hills and have a rich shipment ready to load.

—Haggerty and Farrell are making a shipment from the Beaver lode of the Galt.—Merzner, Graves and Brown, Martin and Watzholl, Sheldon and Kunsumen, and Doyle and Worthington are each shipping a carload of ore from the Neihart Silver Mines property.

Dan Foote and Ed Fossum, who recently obtained a lease on a claim on the north side of old Baldy, owned by George Nelson, are reported to have found a vein five inches in width which assays \$1000 per ton.—Jack and George Powers are opening up the Lizzie, near the Silver Belt.—There are now four sets of workers leasing at the famous Big Seven mine of the Barkers. Glover and Johnson, who are at the Big Seven, will soon make a shipment.

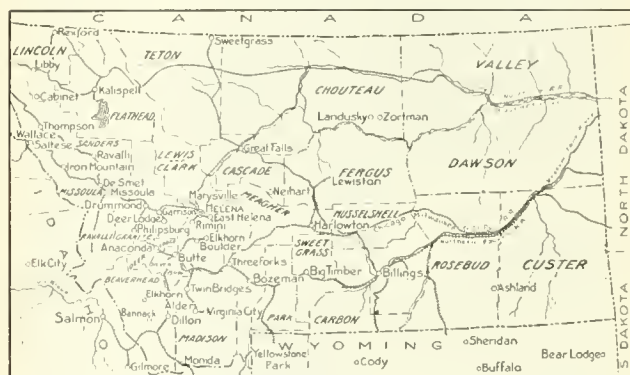
NEVADA

Ely.—The Nevada Consolidated recently fired seven 6-in.

100-ft. holes loaded with two tons of black powder and one-quarter ton of dynamite. The holes were drilled over a surface 230 by 70 ft. Another blast in which an equal quantity of powder will be used will be fired in a short time. This work is being done to consume the powder on hand.

Goldfield.—Consolidated lessees during April shipped seven carloads of ore of medium grade. An important find has been made by Simpson, Grimm, and McIntee 30 ft. below the surface at a point 300 ft. north-west of the Combination shaft. They are working in a seam of high-grade ore that is thought to be in the top of the old stopes. They have saved 35 tons of ore assaying more than \$100 and there is enough ore in sight to make a 50-ton shipment of this grade. Poffinberger and Dunn shipped three carloads last month from near the Combination shaft and they are still in ore. One carload was shipped from the Miller lease on the January vein, near the surface. Marcotte and Petrucci, on the fourth level of the Mohawk, shipped two carloads and are still in ore. The number of lessees continues to increase and the success of Simpson, Grimm, and McIntee has encouraged the holders of the various blocks.

Grantsville.—Elmer M. Bray and Jay A. Carpenter have taken a three-year lease on the Alexander or Webster mine



Map of Montana

and have started remodeling the cyanide plant to treat 40 tons of ore daily. The Alexander mine supplied ore for a 40-stamp mill for several years in the '70s and '80s, yielding \$2,000,000 in silver bullion. The ore was crushed dry in the batteries, given a chloridizing roast, and then amalgamated. At water-level the ore became a base lead, zinc, and iron sulphide ore and with the steady drop in the price of silver, the mine was abandoned in 1890.

Pioche.—The first ore-bed found by drilling has been passed through by the Pioche shaft. This bed contains low-grade ore and the shaft, now more than 700 ft. deep, is being continued to the second bed, which is richer. This second bed will be reached in 100 to 150 feet.

Rawhide.—Owners and lessees who have been in Rawhide since the 'boom' days 12 years ago, George Trost, Giles Hard, Joseph Feretta, Adolph Miller, Joseph Kelly, H. L. Spencer, John Curley, John Haines, and others, now see an opportunity to make money from low-grade ore when the mill is built by the California-Nevada Milling Co. The Western Machinery & Engineering Co., of Reno, has the contract for building the mill, and machinery is being hauled from Fallon by 12-horse teams. The capacity of the plant will be 25 to 50 tons daily, according to the grade of ore treated, and the milling charge will be \$8.50 to \$20 per ton. At present \$60 material is not ore because of the costly 45-mile haul to Fallon and the high railroad freight-charge, together with high treatment cost at the smelters. Trost has in sight 500 tons of medium-grade ore in the Grutt Morning Star Fraction. Thomas Wilson, working 1½ miles

from the Black Eagle, has stripped for 120 ft. a vein of rich ore that is 2 ft. wide. He has sunk a 40-ft. shaft on the vein and is now drifting. About 25 tons of ore in a dump at this shaft averages \$112.

Rochester.—A wage cut of 50c. from the former Tonopah scale has resulted in a strike of the 115 men employed by the Rochester Silver Mines Corporation and the mine and mill are closed. The Nevada Packard also has announced a reduction of 50c. from the former Tonopah scale. The Packard mine and mill will be started soon, with two shifts, and 125 to 150 tons will be handled daily.

Sweetwater.—A mill and cyanide plant, with a capacity of 150 tons, is planned for the Silverado mine. For two years the property has been undergoing development, and, according to A. G. Anderson of Chicago, president of the Nevada Progressive Mining Co., which owns the property, the construction of a mill is justified. E. F. Hall will superintend the work.

Tonopah.—Frank W. Ingram, State Labor Commissioner, is at Tonopah reviewing the labor situation, in which there has been no change. It is thought that, although Ingram is not at Tonopah to mediate, his visit will have a good effect and he may be able to bring the opposing factions closer together than they are at present. The present attitude of the operators is that they will make no concessions. The history of the causes leading to the present trouble in Tonopah dates from August 17, 1919, when the men struck for a \$1 increase in wages. On October 3 they returned to work without an increase in wages. This trouble was finally settled on November 7, when the operators granted a 50c. bonus in wages and other concessions. It was agreed that when it had been shown to the satisfaction of a Federal mediator that a store to be started by the operators was giving a saving of 50c. per day in living costs the 50c. bonus should be eliminated. February 8, 1920, after the mediator had reported that this saving was being provided by the store, the bonus was withdrawn, according to agreement, and a strike followed. This strike resulted in a 50c. wage increase being granted. This increase had the effect of making permanent the sum paid under the bonus system. In addition to this the operators agreed to continue the commissary. The new scale was \$6 for machine-men and \$5.50 for shovelers, trammers, and topmen. It is the removal of this 50c. increase and an additional 25c. that is the cause of the present strike. It is pointed out by the operators that, even under the new scale, wages would be equal to or higher at Tonopah than in other Nevada districts or districts in other States, and that the scale is only 25c. under what it would have been had the miners abided by the agreement of November 7. It is said that the mines have been making little profit, even with \$1 silver, and that they are being exhausted with inadequate profit to the owners and little revenue to the State. The hoisting-engineers and mechanics will be proportionately harder hit by the new scale than the other workers and it is reported that they are the only ones now standing in the way of a settlement almost completely on the terms of the operators.

Tule Canyon.—The Silver Hills mill started May 10 treating 30 tons every 16 hours. Three shifts are employed. The drift on the bottom level continues in low-grade material that is not ore.

Virginia City.—Walter Reid, metallurgist for the United Comstock, is at Virginia City completing plans for the cyaniding part of the 1000-ton mill to be built by the company. Plans for the other parts have been finished and it is expected that the flow-sheet will be completed in a short time. The Overland group and 10-stamp mill has been taken over by the Comstock Silver.

NEW MEXICO

Hurley.—Improved recovery at the mill of the Chino

Copper Co. is recorded in the annual report for 1920. During the year 70.67% of the copper in the ore was recovered; this is an increase of 5% over 1919, and still better results are expected from improvements now being made.

UTAH

Eureka.—The recent strike on the 925-ft. level at the Eureka Bullion mine is the most important development in the history of the company. A shipment of 40 tons has been made, which averaged \$2.40 in gold, 60 oz. in silver, and 2.5% lead. The place from which the ore is being taken is about 112 ft. from the winze sunk from the 800-ft. level, according to John Bestlemeyer, manager. Two headings are being driven for the development of the ore, which comes in a northeast-southwest break. Ore is showing in both headings, for a width of four or five feet.

Shipments from this district for the week ending April 30 totaled 126 cars, an increase of 6 over the previous week. The Tintic Standard shipped 47; Chief Consolidated, 34; Iron King, 17; Dragon, 9; Iron Blossom, 8; Alaska, 3; Eagle & Blue Bell, 3; Swansea, 2; Mammoth, 1; Colorado, 1; Victoria, 1.

Work of installing a compressor at the Tintic Standard property has been completed. This is one of the largest compressors in the State, having a capacity of 2750 cu. ft. of air per minute; it is situated at the No. 2 shaft. When the transformers are received and installed, the management plans to begin No. 3 shaft, as the two present shafts are unable properly to handle the tonnage of ore and waste from the mine.

Frisco.—Regular shipments are being made from the Quad-Metals mine in this district, according to Grant Snyder, manager of the property. High-grade ore is being taken from the 700-ft. level, the deepest working in the mine. The last shipment to a Salt Lake Valley smelter averaged nearly 100 oz. silver and 48% lead, netting the company \$2700 for 27 tons.

Garfield.—The Garfield smelter is continuing operations, in spite of the complete cessation of operations at the Utah Copper Co. At present two reverberatory furnaces and one converter are in operation. The company recently made a large reduction in number of employees. At present the force numbers about 350. So far as local officials are aware, no shut-down of the plant is contemplated.

Moab.—The Tungsten Products Co., which owns and operates the extensive carnotite properties in Dry valley, has been consolidated with the Radium Company of Colorado, according to H. K. Thurber, field manager for the former company. The enlarged concern will be the largest producer of carnotite ores in the world. There soon will be an increase in production from the Dry Valley and Gateway mines.

Park City.—Ore shipments from the district for the week ending April 30 totaled 1450 tons, as compared with 1321 tons for the preceding period. The Judge companies shipped 761 tons; Silver King Coalition, 586; and the Ontario, 103.

Salt Lake City.—The United States Supreme Court, on writ of certiorari, will review the decision of the United States Circuit Court of Appeals in the case of the Snake Creek Mining & Tunnel Co. v. the Midway Irrigation Co. at Park City. This case involves the right to underground waters issuing from the Snake Creek tunnel. The District Court of Utah decided in favor of the mining company, but its decision was reversed by the Circuit Court of Appeals.

WASHINGTON

Keller.—J. E. Angle, superintendent for the Iron Creek Mining Co., recently found high-grade silver ore in an unexplored part of the property. The ore contains bromides, chlorides, and some sulphides. The company has been working five men all winter, and may erect a cyanide plant.

Spokane.—Lower freight-rates on ore shipped from the

Okanogan and Republic districts to the smelter at Tacoma, with a refund of claimed overcharges in the last two years, was asked of the Great Northern railway by the Arlington Mining Co. at a hearing by the Department of Public Works recently. Reductions in freight-rates asked range from 5 to 10%. The suit of the Arlington company is representative of all miners and shippers of ore in the two districts.

WISCONSIN

Platteville.—Mining in the Wisconsin zinc-lead districts is in a helpless condition and one from which it may be a long time recovering. Two mines operated by the Vinegar Hill Zinc Co., the Yewdall mine at Livingston, and the Unity mine at Day Siding, continued outputting low-grade zinc ore through the month of April, the ore going to the National

able. At the Penna-Benton mine in the Benton district a force of miners has been kept at work constantly and considerable ore is being mined and milled but no shipments are being made. The Black-Jack mine, in the Galena district, has been abandoned and the pumps removed.

Some improvement was shown in the offerings for zinc ore and lead ore the latter part of the month but it is of little material interest as there was but one company in the field in a position to take advantage of improved offerings, this being the Vinegar Hill Zinc Co., which made delivery of about 400 tons of high-grade ore.

BRITISH COLUMBIA

Rossland.—There promises to be greater activity here than for some time. The Consolidated company's mines are



Hauling Ore by Sled from Premier Mine



The Same Work Being Done by Caterpillar Tractor

Separators at Cuba City, for magnetic separation and the manufacture of commercial sulphuric acid. Early in the month the New Jersey Zinc Co. unexpectedly began pulling up the pumps at a number of mines, soon after, power, mining, and milling plants were being dismantled. The mines owned and controlled by the New Jersey Zinc Co. were producing regularly at the time of the shut-down last autumn and it is difficult to understand the apparent abandonment. At Mineral Point, where is an establishment, representing an investment of several million dollars, for the manufacture of zinc oxide and sulphuric acid, a force of men was kept at work until the middle of April. The sulphuric-acid works suspended operations entirely during April and the department making zinc oxide was run with a divided force, one-half of the men working each two weeks out of the month. It is rumored that the plant at Mineral Point will be dismantled and removed but no official confirmation is obtain-

operating, and recently Douglas Lay has arrived from London to assume the management of the Le Roi No. 2 mine, better known now as the Josie. Lay states that machinery for a concentrating plant had been ordered and would be erected as soon as it arrived. There is considerable ore in the mine that is too low grade for shipment directly to the smelter, and it is to handle this ore that the concentrator is planned. Mr. Lay at one time was in charge of the Van Roi mine, at Silverton.—The Rossland Velvet Mines, Ltd., has taken over the Velvet mine, and will push development and production during the year. Last year this property produced a considerable tonnage of ore running from 5% to 20% copper and \$10 to \$20 in gold.

Vancouver.—Work on the design of a new mill to replace the one recently burned at the Britannia mine has been started, and as soon as the plans are completed work on the mill will be started. It is feared that there will be difficulty

in obtaining delivery of some of the machinery, and it is not expected that the mill will be completed before the early part of next year. It is understood that the mill will not differ greatly either in design or capacity from the one destroyed. The Britannia company is in a strong financial position, and will not have to await the insurance settlement before starting work on the new mill. A syndicate has been formed to develop a gold discovery at the Ellen group, Shuttle Island, one of the Queen Charlotte group. The group was staked in 1918, but recently rich gold-quartz ore has been found.—A. J. T. Taylor, president of the Taylor Mining Co., is returning from England, where he went with the object of interesting capital for the erection of a concentrating plant and other equipment at the Dolly Varden mine.

Stewart.—T. A. Graham, of the Riblet Tramway Co., and four expert mechanics have arrived to start the erection of the aerial tramway for the Premier Gold Mining Co. Two carloads of machinery have arrived, and another carload was shipped from Seattle on May 6. The cables are being provided by John A. Roebling's Sons Co.; the running-cable will be $\frac{3}{4}$ in. and will come in 15,000-ft. lengths; the down-track cable will be 1 in. and the return $\frac{3}{4}$ in. Eleven and a half miles of the two last and 23 miles of the first will be required.—Albert Peterson and partner have commenced rawhiding ore from the Silverado group. The ore is said to assay \$1100 per ton.

MEXICO

Monterrey.—J. P. Flynn plans to start development work upon several claims in the Avino district upon which he recently filed. Mr. Flynn was formerly manager for the Avino Mines Co., a large producer of low-grade ore. The Prodigion group of mines in the Colorado district, State of Zacatecas, which has a good record of production, has been taken over by John J. Murphy, an American mining man of Chalchihuites. There are several rich mines in the locality.

Considerable interest has been aroused here over the announcement that the Mexican government has declared forfeited the old Santa Fe and Guadalupe mines in the Partido de Pinos district, State of Zacatecas, and that these properties have been filed upon by a number of Mexicans of the city of Zacatecas. The cause of the forfeiture is not explained.

The Topia Falls Mining & Smelting Co., of Topia, State of Durango, plans to develop a group of claims in that district if its application for title to same is favorably acted upon, it is stated. The claims adjoin the Santa Lucia and San Jose gold-silver mines. It is announced that several ore-reduction mills in the Pueblo Nuevo district, State of Durango, which were closed during the long revolutionary period, are to be repaired and again placed in operation. It is in this district that A. E. Miller is making preparations to start development upon the San Juan mines.—Mexican miners have filed upon the Guadalupe mines in the Inde district, State of Durango, which were recently declared forfeited for non-payment of taxes.

ONTARIO

Porcupine.—In addition to a general speeding up of activity in the producing area much interest is being shown in a widely extended outlying district surrounding the proved goldbearing territory. Active exploration has been commenced in many directions, and the field is likely to extend over a width of ten miles and a length of about 40 miles.

Toronto.—The Ontario government has withdrawn the bill introduced in the Legislature providing for increased mining taxation, owing to the strong opposition met in the mining districts. There is a general feeling of relief among mining men, as great apprehension was entertained that the passage of the measure would discourage investments in mining properties.

PERSONAL

The Editor invites members of the profession to send particulars of their work and appointments. The information is interesting to our readers.

C. B. Lakenan was at Salt Lake City last week.

Hornee V. Winchell was at Salt Lake City recently.

W. C. Campbell has returned from Mexico to Toronto.

Bond Coleman has moved from Pachuca to Tampico, Mexico.

Jackson A. Pearce has returned from Santa Rosalia, Mexico, to Berkeley, California.

F. Benitez is with the Société des Mines de Culvre de Catémou, near Chagres, in Chile.

A. J. T. Taylor, president of the Taylor Mining Co., has returned to Vancouver from London.

W. W. Wishon passed through San Francisco last week on his way to Quesnel, British Columbia.

Linton W. Bates, of New York, is at the St. Francis hotel. He is investigating the use of pulverized coal.

A. J. Ronaghan has been elected secretary of the Utah Copper Co. to succeed K. R. Babbitt, deceased.

E. P. Shove, secretary-treasurer of the Ray Consolidated Copper Co., has returned from China and Japan.

C. W. Corfield, chief electrical engineer for the Utah Copper Co., has returned to Carfield from New York.

T. A. Rickard will deliver the Commencement address of the Montana School of Mines at Butte on June 3.

E. J. Franklin, consulting mechanical engineer for the Ray Consolidated Copper Co., is at Salt Lake City.

R. Van A. Mills, petroleum technologist of the U. S. Bureau of Mines, was in San Francisco during April.

Henry E. Wood passed through San Francisco on his way from Los Angeles to the Cat Creek oilfield in Montana.

E. C. Lane, chemist at the San Francisco laboratory of the U. S. Bureau of Mines, has left for an extended Eastern trip.

J. Nelson Nevius is at the new silver district, Silverhorn, Nevada, doing geologic work for some of the companies operating there.

J. M. Bidwell, manager of the Utah Department of the American Smelting & Refining Co., has returned to Salt Lake City from New York.

Charles Bocking, manager for the Butte & Superior Mining Co. at Butte, is in New York. He stopped at Salt Lake City and St. Louis on his way.

C. F. Kelley, president of the Anaconda Copper Mining Co., accompanied by B. B. Thayer, vice-president, visited Butte and Anaconda last week.

C. V. Jenkins has been elected treasurer of the Utah Copper, Chino Copper, and Nevada Consolidated Copper companies. His headquarters will be in New York.

W. S. McCormick, the well-known banker of Salt Lake City, and prominently identified with the financing of mining companies during the past fifty years, submitted to an operation on May 3 for the amputation of his right leg above the knee. The operation was rendered necessary as a result of aneurism of an artery below the knee. While the operation was serious, owing to Mr. McCormick's advanced age, it is believed he will recover.

Albert C. Savage died at Guadalajara, Mexico, on May 3. For nearly thirty years he had been living in Mexico; for the last ten years he was in the employ of the Esperanza Mining Co., at El Oro. Last summer he was injured by falling from a horse, and this injury proved fatal. He was 73 years old, having been born in New York in 1848, the son of William Savage, one of the pioneer railroad men of the United States.

THE METAL MARKET



METAL PRICES

San Francisco, May 10

Aluminum-dust, cents per pound.....	75
Antimony, cents per pound.....	7.50
Copper, electrolytic, cents per pound.....	13
Lead, pig, cents per pound.....	5-6
Platinum, pure, per ounce.....	\$75
Platinum, 10% iridium, per ounce.....	\$105
Quicksilver, per flask of 75 lb.....	\$50
Spelter, cents per pound.....	7.50
Zinc-dust, cents per pound.....	12.50-15.00

EASTERN METAL MARKET

(By wire from New York)

May 9.—Copper is inactive and stronger. Lead is dull and higher. Zinc is quiet and steady.

SILVER

Below are given official or ticker quotations for silver in the open market as distinguished from the fixed price obtainable for metal produced, smelted, and refined exclusively within the United States. Under the terms of the Pittman Act such silver will be purchased by the United States Mint at \$1 per ounce, subject to certain small charges which vary slightly but amount to approximately three-eighths of one cent. The equivalent of dollar silver (1000 fine) in British currency is 46.65 pence per ounce (925 fine), calculated at the normal rate of exchange.

Date	New York cents	London pence	Average week ending	Cents	Pence
May 3.....	61.37	34.87	Mch. 28.....	57.69	33.45
" 4.....	61.37	35.00	Apr. 4.....	56.92	32.98
" 5.....	61.87	35.25	" 11.....	58.00	33.54
" 6.....	60.75	34.75	" 18.....	60.18	34.83
" 7.....	62.50	35.50	" 25.....	60.22	34.77
" 8 Sunday.....			May 2.....	60.68	34.70
" 9.....	61.62	35.12	" 9.....	61.58	35.08

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.	141.12	132.77	65.95	July	106.36	92.04	...
Feb.	101.12	131.27	59.55	Aug.	111.35	96.23	...
Mch.	101.12	125.70	56.08	Sept.	113.92	93.66	...
Apr.	101.12	119.56	59.33	Oct.	119.10	83.48	...
May	107.23	102.69	...	Nov.	127.57	77.73	...
June	110.50	90.84	...	Dec.	131.92	64.78	...

COPPER

Prices of electrolytic, in cents per pound.

Date	Average week ending
May 3.....	12.37
" 4.....	12.37
" 5.....	12.50
" 6.....	12.50
" 7.....	12.50
" 8 Sunday.....	
" 9.....	12.50

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.	20.43	19.25	12.94	July	20.82	19.00	...
Feb.	17.34	19.05	12.84	Aug.	22.51	19.00	...
Mch.	15.05	18.48	12.20	Sept.	22.10	18.75	...
Apr.	15.23	19.23	12.50	Oct.	21.66	16.53	...
May	15.91	19.05	...	Nov.	20.45	14.63	...
June	17.53	19.00	...	Dec.	18.55	13.18	...

LEAD

Lead is quoted in cents per pound, New York delivery.

Date	Average week ending
May 3.....	4.50
" 4.....	4.75
" 5.....	4.87
" 6.....	5.00
" 7.....	5.00
" 8 Sunday.....	
" 9.....	5.00

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.	5.60	8.65	4.96	July	5.53	8.63	...
Feb.	5.13	8.88	4.54	Aug.	5.78	9.03	...
Mch.	5.24	9.22	4.06	Sept.	6.02	8.08	...
Apr.	5.05	8.78	4.32	Oct.	6.40	7.28	...
May	5.04	8.55	...	Nov.	6.76	6.37	...
June	5.32	8.43	...	Dec.	7.12	4.76	...

TIN

Prices in New York, in cents per pound.

	1919	1920	1921		1919	1920	1921
Jan.	71.50	62.74	35.94	July	70.11	49.29	...
Feb.	72.44	59.87	32.16	Aug.	62.20	47.60	...
Mch.	72.50	61.92	28.87	Sept.	55.79	44.43	...
Apr.	72.50	62.17	30.36	Oct.	54.82	40.47	...
May	72.50	54.99	...	Nov.	54.17	36.97	...
June	71.83	48.33	...	Dec.	54.94	34.12	...

ZINC

Zinc is quoted as spelter, standard Western brands, New York delivery, in cents per pound.

Date	Average week ending
May 3.....	5.45
" 4.....	5.45
" 5.....	5.45
" 6.....	5.45
" 7.....	5.45
" 8 Sunday.....	
" 9.....	5.45

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.	7.44	9.58	5.86	July	7.78	8.18	...
Feb.	6.71	9.15	5.34	Aug.	7.81	8.31	...
Mch.	6.53	8.93	5.19	Sept.	7.57	7.84	...
Apr.	6.49	8.76	5.33	Oct.	7.82	7.50	...
May	6.43	8.07	...	Nov.	8.12	6.78	...
June	6.91	7.92	...	Dec.	8.69	6.03	...

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, according to quantity. Prices, in dollars per flask of 75 pounds.

Date	Average week ending
Apr. 12.....	45.00
" 19.....	45.00

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.	103.75	89.00	50.00	July	100.00	88.00	...
Feb.	90.00	81.00	48.75	Aug.	103.00	85.00	...
Mch.	72.80	87.00	45.88	Sept.	102.60	75.00	...
Apr.	73.12	100.00	46.00	Oct.	86.00	71.00	...
May	84.80	87.00	...	Nov.	78.00	56.00	...
June	94.40	85.00	...	Dec.	95.00	52.50	...

DECREASE IN OUR FOREIGN TRADE

The fall in world prices is an important factor in the recent reductions in the foreign trade figures of the United States. Now that we get the details of the March figures, says a statement by The National City Bank of New York, and are able to note the groups of articles in which the big fall-off occurs, it becomes evident that a large part of the reduction in 'total values' is due to the greatly reduced prices at which the merchandise entered or left the country.

March imports as a whole show a fall of 52% as compared with the same month of the preceding year, but when considered by groups, we find that 'raw material for use in manufacturing' shows a reduction of 62%, 'foodstuffs' 52%, and 'manufactures' 45%. This tremendous fall of 62% in the value of manufacturing material imported, suggests on its face that the manufacturers of the country have greatly reduced their activities, but when we examine the prices at which material of this character is being imported as compared with those of a year ago, the fall-off in 'total value' is less alarming. Cotton, wool, silk, and hides are the more important features of the group 'manufacturing material', and when we find that the average price per pound of cotton imported in February (the latest month for which price figures are available) averaged but 21c. per pound against 43c. in March of last year, the fall of 62% in 'total value of manufacturing material' seems less alarming. In many others of the raw materials conditions are somewhat similar; raw silk imported in February 1921 averaged only \$5.66 per pound against \$12.28 in March 1920; clothing wool 22c. per pound against 66c. in March of last year; combing wool 17c. per pound against 52c.; cattle hides 17c. per pound against 35c.; and calf skins 23c. per pound against 63c. a year earlier. In the foodstuffs group, in which the fall-off was 52%, raw sugar is by far the biggest factor, and the imports of February 1921 were at 4.8c. per pound against 8.3c. in March 1920.

On the export side, lower prices are also responsible for a considerable part of the big fall-off. The group 'raw material for manufacturing' shows in March 1921 a fall of 69% in total value when compared with March 1920, but when we find that the average price per pound at which raw cotton was exported in February 1921 was 17c. as against 42c. in March 1920, and realize that cotton is the chief factor in this group, the fall-off of 69% in value is in a considerable degree explained. Foodstuffs exported in March 1921 are 40% less than in March 1920, and a part of this is due to the fact that flour exports in February 1921 averaged \$8.37 per barrel against \$11.35 in March of last year; corn 85c. per bushel against \$1.60; dried apples 9c. per pound against 22c.; lard 15c. per pound against 27c.; and cottonseed oil 8c. per pound against 24c. in March of last year. Manufactures ready for use show a fall of 45% in the March exports as compared with those of March 1920, but when we find that unbleached cotton cloth exported in February 1921 averaged only 12c. per yard against 22c. in March 1920, and that a similar reduction runs through the cotton and many other lines, a part of this reduction in total value of manufactures exported is explained, though it is proper to add that the various classes of iron and steel manufactures, and those of mineral oil, show little reduction in 1920 prices as compared with those of the corresponding date in 1920.

MONEY AND EXCHANGE

Foreign quotations on May 10 are as follows:

Sterling, dollars:	Cable	3.99 1/2
	Demand	4.00 1/2
Francs, cents:	Cable	8.49
	Demand	8.53
Lire, cents:		5.26
Marks, cents		1.61

Eastern Metal Market

New York, May 4.

None of the markets is active, but a good tone prevails; prices are steady to firm in all cases.

Buying of copper is moderate; prices are steady. Japan has bought again.

Demand for tin is light; the prices are firm.

Lead has advanced but buying is not heavy.

The zinc market has turned quiet but quotations are steady.

Antimony is featureless and without change.

IRON AND STEEL

Recent comment in the consuming trade has indicated an expectation that price reductions made by the Steel Corporation, effective April 30, were transitional and the question has been raised whether a further decline might come in case the Corporation reduced wages. A partial answer, says 'The Iron Age', is the estimate that the 20% wage-reduction just announced represents \$4 per ton on full operation of Corporation plants. The price reduction of April 30 averaged \$7 to \$8 per ton. In the light of April's scale of operations it seems hardly likely that the earnings for that month can be much over half of those of March. Steel Corporation operations continue at less than a 40% rate. Whether the wage-reductions will cause hesitation in placing orders, in the hope of still lower prices, is yet to be developed.

Generally the better sentiment apparent in the industry last week continues. Further business from automobile makers is in part responsible for it, although this is largely the filling-in of gaps in stocks to produce salable products.

The April output of pig-iron was a daily average of 39,768 tons, or less than any daily rate since July 1908, when the country's capacity was much smaller. The total for the month was 1,193,041 tons, while that of March was 1,595,522 tons or 51,468 tons per day, itself a figure which was the lowest since late in 1914.

Fifteen furnaces were blown-out or banked in April, but nine were blown-in. The net reduction of six left 96 furnaces in operation on May 1, producing at a rate of 38,505 tons per day, against 102 on April 1, producing at a rate of 43,530 tons. On October 1, 1920, there were 319 furnaces in blast at a daily rate of 106,220 tons.

COPPER

Generally the market is inactive with domestic business confined to small lots for moderately early delivery, May-June. The only heavy buying has been another purchase by Japanese interests of about 1500 net tons, which makes the total purchased for the Far East in the last two or three weeks about 4000 tons. Quotations for electrolytic copper vary according to the sellers. There are one or two willing to sell at 12.62½c., delivered, for May; others hold at 12.75 and 12.87½c., delivered. The New York quotations are ½c. under these. We quote the market at 12.37½c., New York, for electrolytic, with Lake copper at 12.75c., New York, both for May-June delivery. Forward positions are about ½c. higher.

TIN

There are no features; the market is quiet and prices are steady to firm. Lack of activity is due to two causes: uncertainty as to the outcome in Europe and the initiation of the marine strike in this port. The principal buying of the week took place late last Friday, but the volume was not large; there were sales of spot and future shipment Straits tin at 32c. with a little May-June shipment changing hands at 32.12½c. on Saturday. Spot Straits has hovered around 32c., New York, the past week, with the quotations yesterday

at 31.87½c., New York. The London market was down yesterday about £5 to £6 per ton from a week ago, closing at £168 for spot standard, £170 10s. for future standard, and £175 per ton for spot Straits. The Singapore price yesterday was £179 per ton c.i.f. London. Deliveries into consumption in April were 1590 tons, with 2441 in stocks and landing April 30. Imports for the first four months were 5998 tons, against 17,783 tons to May 1, 1920. Tin abroad is reported as 1150 tons.

LEAD

The market is quiet, very firm, and without special feature. Another advance was made last Thursday, April 28, by the American Smelting & Refining Co. from 4.35 to 4.50c., New York and St. Louis, which represents the market, as that interest is regarded as supplying most of the demand, which is not heavy. It is recognized that any large buying could not be supplied by that producer, probably. Independent sellers are asking higher prices, 4.75 to 4.87½c., New York, with the St. Louis price at 4.50 to 4.60c. They are doing a little business at these prices. An interesting development is the arrival last week of 5000 tons of foreign lead, probably Spanish, at this port.

ZINC

The activity on the part of galvanizers that characterized the last two or three weeks has slackened. Producers are generally firm in their attitude and are holding firm in their ideas of prices and are not inclined to force the market. Many of them parted with their April output and are content to await May developments. Some are asking a minimum of 5c., St. Louis, for prime Western, but this grade can be bought in moderate quantities at 4.95c., St. Louis, or 5.45c., New York, which is the market. A year ago this country supplied 75% of the British imports of zinc, but now it is estimated that Germany is supplying 65% of that market.

ANTIMONY

The market is quiet and unchanged at 5.25c., New York, for wholesale lots for early delivery.

ALUMINUM

Virgin metal, 98 to 99% pure, is quoted by the leading producers at 28c. f.o.b. plant, with the foreign grade of the same analysis quoted by other dealers at 23 to 23.50c., New York.

ORES

Tungsten: Inquiries are reported more numerous and the market shows improvement. Sellers are waiting tariff developments and are not ready sellers, especially at the buyers' ideas of prices. Chinese ore is quoted at 3.25c. per unit, with Bolivian and other grades higher or from \$3.50 up per unit.

Ferro-tungsten is inactive and nominal at 58c. per pound of contained tungsten in lump form, guaranteed quality.

Molybdenum: Regular concentrate is quoted at 55 to 60c. per pound of MoS₂ contained.

Manganese Ore: High-grade manganese ore is offered as low as \$22.50 per unit, seaboard, without takers. The nominal quotation is 25 to 30c. per unit.

Manganese-Iron Alloys: The markets for both ferro-manganese and spiegeleisen are stagnant. Quotations are nominal at \$90 delivered, for American ferro-manganese and \$32 to \$36, furnace, for spiegeleisen, 20%.

Ferro-chromium is quoted at 16 to 16.50c. per pound of contained metal in 6 to 8% carbon material.

Ferro-silicon, 50%, can be bought at \$80 per ton, delivered.



T. A. RICKARD, Editor

DEPRECIATION in the market value of Government securities is illustrated in the annual report of the Miami Copper Company, the loss to the company as a result of the sale of such bonds during 1920 amounting to \$333,199.41. A mining company may be excused for parting with its Liberty Bonds before maturity; it is certain that when they were bought the rate of depreciation was not anticipated.

PHILADELPHIANS are proverbially slow, but, we venture to add, dependable. We are informed that a local Section of the Institute was organized in Philadelphia on May 16, this date having been selected because it was the semi-centennial anniversary of the founding of the Institute, an event that happened at Wilkes Barre, Pennsylvania, in 1871. The occasion was marked by an address from Dr. Henry Drinker, one of the founders of the Institute. Our friend, Mr. F. Lynwood Garrison, is secretary of the new Section, to which we wish good luck.

EFFICIENT fireproofing of underground workings is being recognized as a logical form of insurance. At the Anaconda Copper Mining Company's properties, according to the annual report, the value of a protective coat of 'gunite' is appreciated. During the past year cement-guns were used to coat the shafts at the Bell mine for a depth of 1681 feet, the main station and the power station at the 2800-foot level, all the magazines for powder, fuse, and caps in many of the mines, as well as many thousand feet of cross-cuts, mine-exits, and surface-adits of the shafts. Simplicity and ease of application are among the advantages of this method of providing a protective coating, which accounts largely for its increasing popularity.

REVIVAL of interest in gold mining is anticipated by keen observers abroad, as well as among our own people. For example, Sir William Dalrymple is quoted in the London 'Financial Times' as saying: "I cannot help thinking, in view of the strange conditions, industrially and financially, all over the world and the impossibility of countries to buy or provide money for improvement schemes entailing the use to a large extent of base metals, that investment in sound gold production is much safer and more reliable in the matter of profit for

the next two or three years." With this we agree, although an improvement in the copper market, to which we look forward confidently, will restore a large measure of activity to that branch of the mining industry also; indeed, mining generally is bound to come to its own as the process of deflation comes to an end and the normal expansion of industry makes its demand on the production of the metals. So long as civilization endures, there will be need for metals.

OPINIONS amount to but little unless they are voiced, and voiced to those who should hear them. Mr. J. N. Houser, the general manager for the Tennessee Copper Company, reports that he is continuing the practice of meeting with a large committee of the employees about once a month, for the discussion of matters of individual and mutual interest and concern; the result has been that the entire organization is co-operating to a degree that is creditable to all concerned. Too much attention cannot be paid to the advantages of frequent personal contact; it generally results in the avoidance of mistrust, it increases confidence, and it usually leads to an appreciation of the fact that industrial operations are, or should be, carried out for the benefit of employer and employee alike.

RAILWAYS are an important factor, not only in opening up new mining districts, but in throwing the spotlight of enlightened public opinion on mining enterprises and on the manner in which they are conducted and managed. We learn with interest, from a consular report, that a contract has been signed between the Government of Bolivia and one of our engineering firms, for the financing and construction of a railway to connect Atocha, in Bolivia, with La Quiaca, in the Argentine, a distance of 126½ miles. The road is to be completed by August 1, 1925; the cost will be met by a loan of \$7,000,000. Previous concessions to French and Argentine firms have lapsed on account of non-fulfillment; the consummation of the project is now assured. The completion of the road will give South America its second transcontinental railway, which will be especially welcomed, not only during those periods of heavy weather when the Santiago-Mendoza line is unworkable, but at all times to mining engineers and travelers who wish to cross the Andes without going so far south as

Valparaiso, and who wish to visit Bolivia on the way. The new road will serve two excellent purposes besides: it will give Bolivia an additional outlet to the coast; and better communication with the mineral deposits of Bolivia will, it is hoped, induce the Argentine authorities to pay more attention to the development of their own country in this respect. As our friend Mr. W. E. Simpson once remarked, the mining engineer in Argentina is classed as a sort of confidence-trick man who can hypnotize his listeners with entrancing reports of limitless wealth in some inaccessible region, and get them to part with their cash while under the delusion that they are being enriched. Direct rail connection with a prosperous mining region will do much to restore Argentine confidence in an industry that is at least as legitimate as agriculture.

THE annual report of the Dean of the graduate school of the University of North Carolina, Dr. Edwin Greenlaw, contains so many pertinent truths on the subject of research that it is deserving of a wider audience. The modern university, he insists, is concerned with the addition to knowledge as well as the transmission of knowledge. The vitality of the university depends on the proper balance of these functions. There are many who maintain that research is not within the province of the State university, which they would limit to utilitarian work. There are others who maintain that research in the true sense is only possible in the richly endowed universities, in urban centres, where great libraries and laboratories are available; it is profoundly true that scholarship, in order to be effective, requires honor, freedom, and material resources. Contempt for the research man or a perfunctory attitude toward his work, a burden of committee and class-room labor that saps his vitality, the lack of the materials whereby he may carry on his investigations—these kill the spirit of research. On the other hand, a great library and laboratory equipment may be used only in a perfunctory way, or not at all. There are all sorts of research men, as there are all sorts of senators, or business men, or physicians. Genius is a matter of the spirit and of the intellect. Where the spirit is present the results somehow come. The field for service, says Dr. Greenlaw, lies in quality, not in numbers. The purpose is not to attract a miscellaneous collection of degree-holders who want another degree, but to find the superior student who will do superior work. A small group of students who are certain to attain distinction in research will enable the University to render a service that would otherwise be impossible if a race were attempted with other universities for superiority in numbers. Given a group—not a large group, for the world's supply of such men is small—all of whose innermost life is bound up in research and in the creation of the spirit of research in young men, and the future is assured. Writing with reference to material encouragement and support, the Dean says that "even when salaries are advanced, high-school and college teaching cannot compete, in the material rewards

that are regarded as tests of a successful career, with commerce and the other professions. The one and only hope for meeting this competition lies in the development of a passion for research, for the things of the mind, for learning as a divine calling. Transformed by a new idealism, it will become the great and abiding hope for bringing about that respect for scholarship that is to enable us to meet the challenge of a material civilization. . . . Business organizations are ready to employ brilliant young graduates at salaries that were unheard of a few years ago. The very type of man who would, other things being equal, devote himself to research, is most certain to be confronted by the subtle temptations of salary and of worldly opinion. Our service depends on our ability to hold the first-rate man, not the second- or the third-rate one". In other words, research, which after all is nothing more than the occupation of the scientist, deserves encouragement, sympathy, and facilities; it must be carried out by men of keen analytical and dissective minds, men with experience, knowledge, perception, logic, and a capacity for unlimited perseverance; nothing will be achieved by making it a means of livelihood for mediocrities.

THE committee appointed by the Mining & Metallurgical Society of America to consider the question of post-graduate education, consisting originally of Messrs. R. Gilman Brown, Fred Hellman, R. C. Gemmell, Pope Yeatman, and later including Professor Robert Peele and Mr. H. H. Knox, has rendered its report. Mr. Brown, as chairman, is a resident of London, and so was able to gather first-hand information and to form sound conclusions as to the success of the scheme of post-graduate education that was launched about nine years ago by the Institution of Mining & Metallurgy. The conclusions reached by the chairman were that the British plan had been a success, that it fills a definite want peculiar to the country but almost non-existent with us; the success, in Mr. Brown's opinion, has been due largely to the fact that the Institution "is fortunate in having a permanent, whole-time official [Mr. Charles McDermid, the secretary], possessing a high personal standard, coupled with rare tact and personal magnetism in dealing with young men" as well as, we would add, with the older members of the Institution. The realization of the importance of personal influence and sympathy has led Mr. Brown to propose a scheme of post-graduate assistance for would-be mining engineers in this country, by which "the true aims of professional life could be brought into their proper perspective; an idealism fostered that would be practical and not the mere chasing of rainbows; mere money-getting as such put second to the duty owed through our profession to our fellows; less thought of what we get from our work by recognizing that those receive most who give most; a perception that some wealth costs too much". This 'godfather' idea assumes the proper selection of graduates, and also the place of their work. The men who will undertake the task must be volunteers, they must be

mature, of sympathetic nature, wise, and of high ideals; and they must be ready to find leisure to devote to their godsons. There should be, as Mr. Brown points out, a sufficient number to whom such idealism appeals, who feel impelled to some other achievement than mere material success, and who are convinced of the duty of service. It is hoped that the proposal will meet with the support it deserves.

GENERAL satisfaction will be felt among members of our profession at the confirmation of Mr. Bain's nomination as Director of the U. S. Bureau of Mines. A few days ago many of us were surprised to hear that his nomination was endangered by the fact that the two senators from California were unwilling to endorse it. By custom, entitled 'senatorial courtesy', a citizen of a State cannot be appointed to an office needing confirmation by the Senate if a Senator from his State blocks the way. Mr. Bain is not a politician and therefore was a person of no consequence to the Senators from California, whose sum total of political patronage was reduced by the appointment of a mining engineer from California to the Directorship of the Bureau. In effect, they said, "Who is this Mr. Bain, we don't know him", and thereby the confirmation of the appointment was held up. This is the way the spoils system works. If the Senators did not know Mr. Bain, it was their fault, not his. He had lived in California, honorably and prominently, for eight years before he went to London as editor of 'The Mining Magazine' and to China as a consulting engineer for an American syndicate. During the War he came home to serve as assistant to the then Director of the Bureau of Mines, Mr. Van. H. Manning, and acquitted himself so well that general pressure was brought on him to accept the position when Dr. Cottrell resigned a temporary tenure of the office. The Senators from California might have known this if they had cared to be well informed on the subject; they had only to ask the Secretary of Commerce or the Director of the Geological Survey to learn all about Mr. Bain that it was necessary for them to know before acquiescing in his appointment. Instead, the president of the American Mining Congress, the president of the Engineers Club of San Francisco, the State Mineralogist, and others had to send telegrams to the Senators, assuring them that Mr. Bain was highly regarded by the mining engineers and mine operators not only of California but of the entire country. However, all's well that ends well. The incident served chiefly to accentuate Mr. Bain's high reputation and the esteem in which he is held.

A Company Meeting

The annual meetings of mining companies in London are usually rather stupid affairs, to which the chairman contributes a labored speech, reminding one of Milton's angels, whose speeches we read with respect and end with relief. The ensuing remarks of the shareholders usually disclose an abysmal ignorance of mining. Indeed the whole performance is steeped in bathos, and

seems to give to mining the touch of opera bouffe that Mr. Algernon Moreing ascribed more particularly to an Italian venture many years ago. Such was our mood when we started to read the account of the Camp Bird meeting as reported in the 'Financial Times' of April 21. First came the speech of the chairman, Mr. F. A. Govett, a gentleman who in times past has provoked a smile by his humptionsness, but who has lived down the effects of an excessive self-appraisal by his sincerity of purpose and his achievements as a leader of mining finance in the City of London. On this occasion he acquitted himself well. The company was in dire trouble; he told the shareholders the exact position, frankly and fairly. The drop in the price of silver had put an end to the profits from the Santa Gertrudis mine in Mexico, a fire had stopped production for several months before the silver market collapsed; then, when repairs had been made, a drought had caused a shortage of electric power, and, of course, a further decrease of profitable activity. Besides this the company had used its accumulated profits in subscribing heavily to the shares of the Mexican Corporation, the National Corporation, and the Mexican Chemical & Metallurgical Company, all three of which were started during a hectic boom, in the expectation that the improvement in Mexican political conditions was the precursor of a period of mining expansion. In these undertakings the Camp Bird company has contingent liabilities, on subscriptions not yet fully paid. A new mine, or group of mines, was purchased recently at Pachuca. This, the El Bordo, is looking most promising, but the shortage of power has compelled a severe cut in the capacity of the mill, which was to have been completed in June. Construction of the mill was stopped in February. It was, as Mr. Govett said, "a history of unforeseen disasters", and it came to a climax at a time when the coal strike had plunged England in the deepest depression. He told the story manfully: "The only thing to do is to face the facts and see it through", with that bulldog tenacity, we venture to say, that never loses its grip and never accepts defeat. The British may call it "muddling through", but no foreigner is entitled to apply the phrase contemptuously, because, after all, it involves qualities of heart and mind that command our respect. Mr. Govett rose to the occasion finely; he was followed by a director, Mr. F. H. Hamilton, whom we happen to know. He is an accomplished speaker and a witty one. If the world was "tumbling to pieces", as Mr. Govett had implied, then "nothing much matters", he said. "It is a more profitable question for us to ask ourselves: 'Supposing it is not, what then?'" Thereupon he reminded the shareholders that, if the world was not tumbling to pieces, they had a splendid organization, rich mines, and big interests in Mexico. He himself felt more optimistic than he had felt at any time in the last six months: "One cannot help seeing that in the catastrophic fall we have had in all commodities the turn of the tide seems to have come." As we read the account of this meeting we feel impelled to extend a friendly hand to our mining

friends across the water. We on this side have troubles of our own, notably the temporary collapse in copper mining, but our misfortunes are light compared with those which hang so tenaciously to the shoulders of the mining fraternity in London, for there the slump in mining is part of political and industrial complications which have been so persistent that even a brave soul might well begin to despair. They will not despair; of that we are certain; they are not made of despairing stuff. We wish them better luck heartily, and believe that it will come in due course.

The German Reparations

It seems that the latest conditions formulated by the Supreme Council of the Allies are to be accepted by the German government. We say "it seems" because there is no positive assurance that the German policy of postponement and evasion may not yet defeat the effort to make an end of the miserable wrangle. The total sum is equivalent to 33 billion dollars, at the normal rate of exchange. A tax of 26% is to be levied on exports, of which 1% is to be set aside for a sinking-fund and 25% is to be applied to the interest on the three bond issues into which the entire sum of reparations is to be funded. A sum of two billion gold marks, or \$480,000,000, is to be paid yearly in redemption of these bonds. As to whether 33 billions is excessive, it needs to be remembered that the payments are spread over 42 years and that the present value of the reparations at the usual rate of interest is only about 12 billion dollars. Further, it has been acknowledged in the Reichstag that the German government that waged the war had intended to exact 30 billions from the United States, a similar sum from Great Britain, and 40 billion dollars from France, not as reparations for damages actually done but as punitive indemnities. We believe that the demand made upon Germany is just and that she can afford to pay it. As soon as the bonds are issued, in furtherance of this international settlement, we shall hear all about Germany's resources and her ability to make good, as we believe she can, if she sets herself honestly to do so. German industry is well on its feet and is competing successfully in the world's markets. "Germany can put a ton of steel in England at a price \$20 per ton cheaper than England can make it", says Mr. Charles M. Schwab. Pneumatic tools from Germany are now being sold in Detroit, says the same authority. Unquestionably the rate of exchange as between the mark and the dollar or pound is such as to offer great advantage to the German manufacturer and he will avail himself of it, of course; indeed, the heavy reparations will serve to foster German foreign trade, particularly in South America and the Orient. That was one reason why the Labor party in England opposed the exaction of adequate reparations, fearing the consequence would be to flood the world with goods of German manufacture and to throw the workers in other countries out of employment. The next question is, who will buy the German bonds? The distribution of reparations to the

Allies is fixed in the proportion of 52% to France, 22% to the British Empire, 10% to Italy, 8% to Belgium, and the remainder to Japan, Portugal, and others. Presumably the Allied governments will wish to transfer the German bonds to this country in exchange for our exports to them. It is unlikely that England or France will guarantee the German bonds, unless the United States prove willing to accept them in payment for existing loans, but such a transaction would, we think, meet with general disapproval among our people. An offering of German bonds without the guarantee of the English and French governments would be a failure except at a discount large enough to incite speculative buying; they would hardly rank higher than German currency, which is at 6% of parity. We fear that these German reparations may make trouble yet. Judging from the behavior of the Germans since the Armistice, it seems unlikely that they will abide manfully by their agreements in this matter, so that we may expect delays in the payment of interest and possibly a repudiation, under the cloak of necessity, of the contract. The German scrap-book is a notable volume already. Any delay or repudiation in the matter of the successive payments due under the reparations agreement will provoke the Allies to coercion, military and economic, and will thereby sow the seeds of future conflict. Fortunately our Government acted unequivocally and firmly in refusing to be used as a cat's paw by Berlin; indeed, the reply made by President Harding, through the Secretary of State, contributed largely to the settlement, by bringing the moral pressure of the United States into action just when it was needed. If in the future, as in the recent past, the United States should indicate that it will refuse to assist Germany in any tricky evasion of her obligations, it may be possible to prevent trouble, meaning warfare in Europe, on this account. Only a just firmness on the part of those who brought the War to an end can prevent an unrepentant Germany from bringing another vast horror upon a sad and weary world.

Destructible Power Resources

The question has been raised as to what extent the present generation should assume a moral responsibility in the matter of the conservation of the natural products that give us heat and energy, the destructible resources of power. Are we to assume that future generations will, by invention and discovery, or by the development of hitherto unrecognized sources of power, make good the wastage occurring at the present time? Or should we restrict our consumption of destructible heat-giving material with an eye to the needs of future generations, and without assuming a continuation of the same rate of inventive and scientific progress that has characterized the 19th and the earlier years of the 20th century? The fact cannot well be overlooked that we are profligate in the consumption of our national assets. Our automobiles numbered a million and a quarter in 1914, and nearly eight millions at the end of 1920; to keep them supplied with fuel we are, to some extent, 'burning the candle at

both ends'. In an attempt to justify ourselves let us examine the possible sources of future supply of power and heat.

The reserves of coal are such that there is no need for immediate apprehension; but extraction is becoming increasingly costly. The domestic consumption of gasoline for 1920 exceeded that for 1919 by over 800 million gallons; it exceeded that for 1918 by considerably over one billion gallons. The world's production of petroleum in 1920 was 688,474,251 barrels, according to the American Petroleum Institute. This represents a gain of 24.2% over the 1919 production. The production in the United States increased from 377,719,000 barrels in 1919 to 443,402,000 barrels in 1920, a gain of 17.4%. The production is now five times what it was in 1901; and this is insufficient for our needs. The significance of the increased demand is seen in largely increased imports. Mexico supplied us with 110,000,000 barrels in 1920, as compared with 57,000,000 barrels in 1919, a gain of 93%. Stocks of oil are being drawn upon as if we were facing a national emergency, the proportion of oil in storage to oil consumed having decreased 5% during the past year; it now represents less than a four-months supply. Fuel-oil is a vital necessary for any country that can boast of a large navy, a large army, or a large military air service. How can future requirements in this respect be assured? At the present rate of consumption the supply from existing sources will show serious signs of diminution within a few decades, assuming no further discoveries of importance. Oil will be developed in other countries, and additional supplies, doubtless, will be forthcoming. The automobile and the motor-truck have come to stay, but their demands have been such that deep inroads have been made into the fuel resources of the world. The rubber requirements of the industry were unconsciously anticipated by a bold adventurer who took the seeds from Brazil in 1876. Today there is an extensive rubber industry in the Eastern tropics, we have learned to re-use salvaged material, and supply exceeds demand; but we have not been able to grow the fuel needed for the millions of rubber-tired vehicles that over-run the country. Substitutes for gasoline are already being used, however. In the district around Pernambuco, in Brazil, there is a thriving sugar-cane industry. The recent high price for gasoline has drawn attention to the value of alcohol for use in internal-combustion engines; and this is now being produced in quantity as a by-product of the sugar mills. Certain disadvantages were apparent at first from the use of the pure spirit, notably in connection with the liability to cause rusting of certain parts of the motor; but this is now prevented by the addition of 5% of gasoline to the alcohol, the mixture forming a standard motor-fuel. It can be obtained at less than half the cost of gasoline, and its value for power purposes is enhanced by the fact that combustion is practically complete, so that there is less 'carbonizing' in the engine. Other cheap and efficient substitutes for gasoline will, we have no doubt, make their appearance from time to time, as the price of the normal article becomes higher. The effect is a concomitant to the cause. The increased demand brings

a realization of a comparative shortage of supply. The price is raised; by some it is considered prohibitive; and a substitute is introduced.

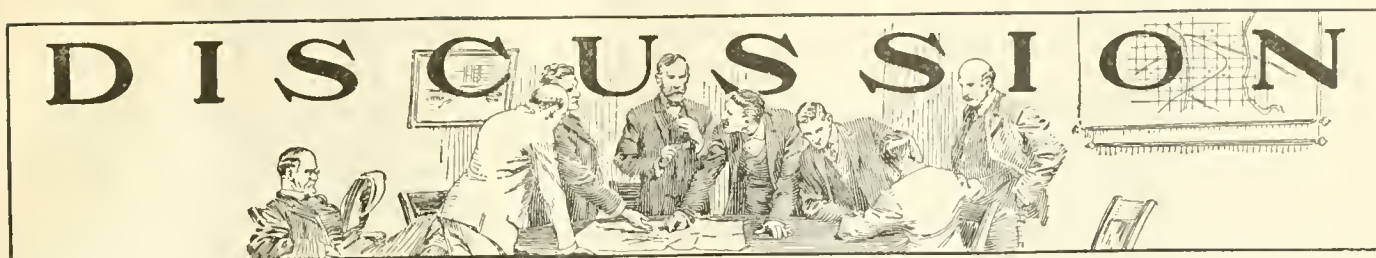
The practicability of utilizing the heat that is known to exist within the interior of the earth is a moot point. As far as high temperatures are concerned, the outer crust has only just been scratched by our mining operations, comparatively speaking; nevertheless, temperature problems are factors that have to be considered in some of the deep mines. Rock temperatures in different mines show that the increase with depth may not be regular. At 6000 feet below the surface in the St. John Del Rey mine in Brazil, the deepest in the world, it is about 115°F.; at 4000 feet it is about 98°F.; so that there is, roughly, a rise in temperature of 1° for every 117 feet of depth. At the City Deep mine, in South Africa, the rock temperature at the 6000-ft. level is given as 89°F.; at 8000 feet it is assumed to be 97°F., showing an increase of 1° per 250 feet of depth. It is obvious therefore that temperature will vary according to locality; in volcanic districts it may be higher than in other places. In certain parts of the world, notably in the Mediterranean region, steam is given off from the ground. Boreholes are made in much the same way as for the drilling of oil-wells, and the steam is utilized for generating power. The presence of steam at the surface of the earth, however, suggests instability; hence it is probable that the power requirements of modern civilization would be small at such a locality. Generally speaking, it may be assumed that we must go a long way in the direction of the centre of the earth if we wish to tap a source of power for industrial operation. The problem has been considered, if not studied. Sir A. C. Parsons, the inventor of the steam-turbine, is credited with the suggestion that a 12-mile shaft would reach a region underground where an almost unlimited amount of heat would be available. It is suggested that this heat might be utilized by the installation of an exchanger, consisting of steel piping that would be used to carry a liquid, of a higher boiling-point than water, to the surface and back again, and that would continuously take up heat from the lower part of the shaft. Problems of no mean magnitude would be encountered; but the idea is no more fantastic than some of the achievements in the 'fairy' tales of Jules Verne must have seemed fifty years ago, but which have since been developed, largely by the aid of electricity, into actualities.

The sun gives off a vast amount of heat, but very little of it is utilized. Successful results are said to have been achieved in Egypt from the practice of heating thin layers of water in closed vessels exposed to the rays of the sun, the heat thus obtained being utilized for power purposes. But Saharas are uncommon and uninviting. Industry does not thrive in such places, and the demand for power would be negligible usually. However, there are exceptions. One of the largest industries in South America is situated on the Chilean pampa, in an arid region, where the sun's rays are scorching, where the atmosphere is abnormally dry, and where high winds are common. There is practically no rainfall. Atmospheric

conditions are exceptionally favorable for solar evaporation, as practised in the salt flats of Utah and California, for instance; it is therefore an amazing fact that practically all the evaporation, and this constitutes one of the major expenses of nitrate recovery, is achieved by the use of steam from oil-fired boilers. In considering the available power resources of the world the fact must not be overlooked that simplification as well as economy may result from the saving of fuel. Boiling in open vats may serve the purpose, vacuum-pan evaporation may be highly efficient when a utilization of the calorific value of the fuel only is being considered, but the sun's rays are there for the taking; and Nature has provided air currents that ensure continual movement and effective evaporation. This evaporation is the source of all our water power, which is merely transformed solar energy. The water in the ocean is evaporated, lifted up, condensed, and deposited at higher levels. In falling again toward the level of the ocean it is made to perform useful work—to drive turbines and water-wheels. These in turn operate electric generators, producing a current that may be used to melt steel. Can the heat production of the sun be duplicated, on a reduced scale, on this planet? To what is it due? Kelvin estimated that a mass of burning coal, the size of the sun, would be consumed in 5000 years; but it is evident that the sun has been giving off its heat for an infinitely longer time than this. The result of the investigations of the Curies and other scientists on radioactive elements offers food for thought and speculation: transmutation is no longer classed among the absurdities of legendary times; it is an accomplished fact. One ounce of radium will give off an amount of energy equivalent to that obtained by the combustion of 10 tons of coal; the emanation will continue for the space of 2500 years. So far, scientists have been unable to retard or to hasten this action; but they have discovered that, in wasting away, another element, helium, is produced. It is not improbable that we are on the threshold of discoveries of vast economic importance. The presentation of one gramme of radium to Madame Curie is one of the most significant tributes to pure science that modern history can record.

Wind-mills are not used to anything like the extent they might be. This is due largely to the fact that they are often of so flimsy a construction that one is inclined to think that their application is limited to farm work. The power obtained in proportion to the capital expended is small, of course; and the output is variable. Nevertheless, there are many places where they could be introduced, and where fuel would be saved. The action of the tides suggests a source of power. The subject is one upon which some misconception exists, so that a few explanatory details will not be out of place. Newton's law of attraction presupposes that the force of gravitational pull is inversely proportional to the distance intervening. Both the sun and the moon attract the earth; but the moon, being nearer, exerts the greater pull. The water of the ocean is sucked into a heap, as it were, at certain places, the earth underneath the water being

subject to a less attraction because of greater distance. Thus we get high tides directly underneath the moon, and low tides at a circle of the earth that is 90° from the sublunar area. At the same time, the sun, with a force equal to about one-third that of the moon, also forms tidal crests of lesser magnitude. Hence we have two low and two high tides every 24 hours and 51 minutes, the fraction of the hour beyond the day being due to the movement of the moon in an easterly direction. When the moon is 'new' or 'full' it is in a direct line with the earth and sun; exaggerated 'spring' tides are the result. When the moon is at half or one-third, it is at right angles to the sun; low or 'neap' tides are the result. It must be explained that tides, as we understand the word, are not due to the immediate action of the sun or moon, but upon transmitted movements that occur, primarily, several thousands of miles away. The rate of such transmission of tidal effect is said to approximate 7000 miles in 12 hours. It has been estimated that the maximum tidal movement in the centre of the Pacific area amounts to 1.95 feet, of which 1.34 feet is due to the attraction of the moon and 0.61 foot to that of the sun. The movement, therefore, is small at the source. How can tidal flow be utilized to give power? In the first place, unusual estuary conditions are essential. At the entrance of the Bristol Channel, the range of ordinary 'spring' tides is 23 feet. At the end of the channel, where the river Severn commences, the rise is 40 feet. Tides of 53 feet have been recorded at Chepstow Bridge. Narrowed channels, therefore, cause an exaggeration of tidal effects; and there are instances where it would seem that an enormous amount of power is going to waste. The subject is being investigated in Great Britain. It is proposed to build an immense barrage, or dam, across the river Severn. The idea is not new, it was first proposed in 1843, but lack of funds prevented the consummation of the scheme. The present proposal, which is still in a preliminary stage of consideration, will probably involve an expenditure of about £15,000,000 for machinery alone. The output, translated into electric energy, is estimated at 260,000 kilowatts per 10-hour day; the cost of current will amount to about 0.4 penny per unit. Power-plant manufacturers are disinclined to co-operate. The equipment required is not of standard design; the load will fluctuate to an abnormal degree; the static head will vary between 6 and 36 feet. Tidal waters are usually heavily charged with silt; and a mechanical problem is introduced that demands attention, not only on account of turbine wear, but also because of the accumulations that are liable to occur in the reservoirs and behind the dams. The geology of the district is to be studied, and attention is to be paid to the probable effect of an increased current. However, greater problems than these have been solved in other branches of human endeavor. Hydro-electric power-plants are usually successful installations, both from the economic as well as from the mechanical standpoint. Hope may be expressed that the success of the new Severn scheme will lead to a better appreciation of the untapped power resources of the world.



Valuing Partly Exhausted Mines

The Editor:

Sir—I read Mr. Morton Webber's recent articles on this subject with much interest, and with approval in most respects. His program of dividing the preliminary development into three stages, the prosecution of each stage depending on the success of the preceding one, is particularly commendable in that it provides for predetermined points in the progress of the work from which the entire project may be reviewed in the light of newly acquired information.

My chief criticism of the paper is that it assumes throughout that the prospective value of a mine lies in the downward extension of ore-shoots exposed in old workings. Examples A and B are both vein deposits. If the entire workings are shown in the illustrations, the drifts have been driven practically no distance beyond the limits of the ore-shoots and apparently the possibilities of finding other ore-shoots along the veins have not been tested by the original operators, nor advised under recommendations for new work, except inadequately in Example A, on Level No. 4. In this example, if Level No. 2 were not caved, its extension to the east would appear to be advisable, but if practical considerations should prevent drifting on this level, then Level No. 1 and Level No. 4 should be driven a very considerable distance. Exploration eastward on Level No. 1 might be obviated by prospecting the outcrop by means of trenches. If it shows no signs of mineralization, work on Level No. 1 may be omitted. Mr. Webber mentions the existence of old stopes to the east. These, if they are near-by, may obviate the necessity for further exploration on Level No. 2; but at the same time their presence strengthens my contention, that, based on the illustration alone, considerable development to the east is desirable.

In Example B, the development work shown outside the orebody is obviously inadequate. The occurrence of an orebody of this size would surely justify the expense of considerable work in search of other ore-shoots in the same vein. The termination of the ore-shoot near the 900-ft. level is only an indication of the vertical depth to which ore may be expected. This should be checked against similar data from other mines in the district, if such exist. But even though commercial ore should be limited to this depth, the possibility of finding other ore-shoots in the same vein or in other veins on the property is a point fully as worthy of investigation as that of extension at depth. Unless there is evidence to the contrary, the prospective value of a partly exhausted mine

may be more in the chance of finding new orebodies than in developing the extension of old ones.

Mr. Webber's statement, "Unless there is collateral evidence from neighboring operations, the exhausted portions of the deposit are the only index to the possibilities of the future", overlooks such evidence as the extent of the outcrop and its character, the existence of other veins on the property, especially if they are reasonably near the original vein and parallel to it. It is not uncommon in the case of two parallel veins to find an ore-shoot on one directly opposite to that on the other. Indeed, in these days of few newly discovered mining districts, it is thought by many that the most favorable localities in which to search for ore are those in which large orebodies have previously been found; and collaterally, that a good place to look for a new ore-shoot is somewhere near one that has already been found. The exhausted portions of a deposit may be taken, however, as an index of the character and grade of other orebodies in the near vicinity, or in a less degree, in the adjoining district.

Horizontal rather than downward exploration has been a successful means of finding ore in many mines. At Tonopah, Nevada, large quantities of ore were found in the Tonopah Mining Company's property by lateral development. It is a matter of common repute that an eminent engineer made an adverse report on the property early in its history, because the ore-shoots then opened did not extend below the 700-ft. level. That was over 17 years ago and the property has been operated continuously and successfully during that time, largely on parallel veins above the 700-ft. level. In the Nevada Wonder mine, at Wonder, Nevada, the original ore-shoot was bottomed at 1000 ft., but an exploratory drift driven 1200 ft. along the barren part of the vein to the south opened a blind ore-shoot that produced \$2,000,000. At Oatman, Arizona, there is a series of five or six valuable shoots of gold ore spaced along the Tom Reed-United Eastern vein. Without a liberal policy of development by drifting, any one of these shoots might have been mined without discovering the others. The point I would make is that, in valuing a partly developed mine, the appraisal of the chances of finding new orebodies is of the utmost importance.

A detailed mapping of geological features is of great assistance in valuing a property, and if possible it should be done before the sampling. Together with the sampling, it will form the basis for the appraisal, not only of the developed or partly developed orebody, but also of the chances of finding other orebodies. An understand-

ing of the geology will often result in a more intelligent sampling; and may suggest points where, because of faults or branching veins, a small amount of development work during the sampling may lead to important results. In fact, it is not a bad thing for the sample-boss to be something of a geologist himself.

I have no doubt that these matters are fully appreciated and practised by Mr. Webber, but his article is under review, and in discussing it, I feel that it is worth while to advance these supplementary considerations.

Referring again to Mr. Webber's article, I call attention to the fact that where waste rock is used for stope-filling, a practice much more common now than formerly, a small mine-dump is no indication as to the amount of dead work, or of selective mining. Where the mine-dump is large, it may indicate extensive exploration, and strong stope-walls that stand without tilling, as well as the things specified by Mr. Webber.

Further, I question the statement that "a mine should be able to earn 7% on the cash investment". That seems inadequate. There would be few mining enterprises of small or medium size initiated if there were not the expectation that the entire capital and a reasonable profit would be returned within a few years. An annual return of 15% is a common demand, but in the case of short-lived mines, it should be larger.

JOHN A. BURGESS.

San Francisco, April 25.

Assessment Work

The Editor:

Sir—Why this suspension of assessment work on mining claims; whom does it benefit? Surely not the legitimate prospector or mine-owner. The owners of the principal mines or claims in this district have not been benefited by the suspension or extension of assessment work, as they are on the ground, pegging away on development, and have their work done early in the year, before the 1919 and 1920 laws were passed, and most of them have done enough work this year to cover their 1921 assessment.

There are only three claim-owners in this district who have not performed their assessment work for 1920; and two of them, I have reason to believe, intended to abandon their claims if the time had not been extended to July 1, 1921. They are not in the camp and have not started any work up to date. Their claims or fractions of claims should or could be justly annexed to other groups or holdings that are trying to revive the camp.

The suspension and extension of assessment work have done injustice to the industrious prospector and claim-owner. There is too much of the public domain blanketed by speculators, people who never intend to do any assessment work and are only retarding gold mining.

If the time for assessment work is again suspended or extended the claim-owners that did their work should be compensated.

W. K. WHITMORE.

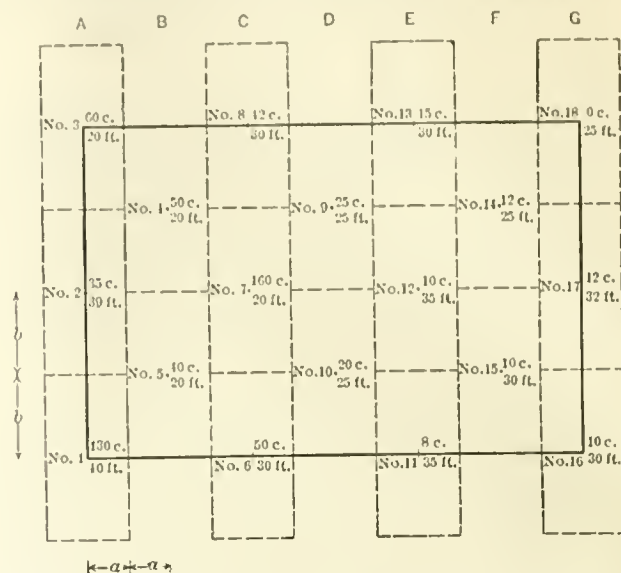
Mohave, California, April 25.

Method of Calculating the Average Value of Placer Ground

The Editor:

Sir—James T. Dixon's method of calculating the average value of placer ground is described by Eugene B. Wilson in his 'Hydraulic and Placer Mining' (pp. 39-44, 3rd edit.); the original plan being shown below.

The heavy dots are 18 drill-holes; the value of gold from each hole is marked on the top in cents per cubic



yard, and below it is marked the depth of the hole in feet to bedrock. The ground to be valued is limited by the lines connecting 1, 3, 18, 16, and 1.

A modified form of calculation, which saves much arithmetical work as compared with Dixon's way, is given in the following tabulation:

	Depth	Volume	Cu. Yd.	Product
1	$a \times b \times 40$	$= 40ab$	$\times 130$	$= 5200ab$
2	$a \times 2b \times 30$	$= 60ab$	$\times 35$	$= 2100ab$
3	$a \times b \times 20$	$= 20ab$	$\times 60$	$= 1200ab$
4	$2a \times 2b \times 20$	$= 80ab$	$\times 50$	$= 4000ab$
5	$2a \times 2b \times 20$	$= 80ab$	$\times 40$	$= 3200ab$
6	$2a \times b \times 30$	$= 60ab$	$\times 50$	$= 3000ab$
7	$2a \times 2b \times 20$	$= 80ab$	$\times 160$	$= 12800ab$
8	$2a \times b \times 30$	$= 60ab$	$\times 42$	$= 2520ab$
9	$2a \times 2b \times 25$	$= 100ab$	$\times 25$	$= 2500ab$
10	$2a \times 2b \times 25$	$= 100ab$	$\times 20$	$= 2000ab$
11	$2a \times b \times 35$	$= 70ab$	$\times 8$	$= 560ab$
12	$2a \times 2b \times 35$	$= 140ab$	$\times 10$	$= 1400ab$
13	$2a \times b \times 30$	$= 60ab$	$\times 15$	$= 900ab$
14	$2a \times 2b \times 25$	$= 100ab$	$\times 12$	$= 1200ab$
15	$2a \times 2b \times 30$	$= 120ab$	$\times 10$	$= 1200ab$
16	$a \times b \times 30$	$= 30ab$	$\times 10$	$= 300ab$
17	$a \times 2b \times 32$	$= 64ab$	$\times 12$	$= 768ab$
18	$a \times b \times 25$	$= 25ab$	$\times 9$	$= 225ab$
Total				$1289ab$
Average				$= 45073 ab \div 1289 ab = 34.96 c. \text{ per yard}$
Area				$48 ab$; Average depth, $1289 ab \div 48 ab = 26.85 ft.$

Average value of the ground $= 45,073 ab \div 1289 ab = 34.96$ cents per cubic yard.

Area being 48 ab; average depth $= 1289 ab \div 48 ab = 26.85$ feet.

JANSHI SEN.

Peking, China, March 21.

Gold-Digging Ants

The Editor:

Sir—This story of Herodotus, referred to in your address on 'Prospecting', published in your issue of April 23, has been classed among the products of pure imagination for 2000 years, but it is founded on facts, as are many other fantastic stories of the old writers. Marco Polo, for example, was long regarded as a champion liar, but the more the investigations have been made in the countries he describes the more he is found to have been an accurate and truthful narrator.

Herodotus has been called the Father of History, and also the Father of Lies, but, while he repeats without guaranty many wild tales, some have been founded on fact. In a journey to Egypt a few years ago I was much amused to see what an accurate and careful observer Herodotus was and how tenaciously the Egyptians have clung to the customs so accurately described by him.

The story to which you refer is found on pages 214 and 215 of the Bohn edition of Herodotus, and is to the following effect:

"There are other Indians bordering on the city of Caspatyrus . . . they are the most warlike of the Indians and these are they who are sent to procure the gold; for near this part is a desert by reason of the sand. In this desert then, and in the sand, there are ants in size somewhat less indeed than dogs, but larger than foxes . . . These ants, forming their habitations underground, heap up the sand, as the ants in Greece do, and in the same manner; and they are very like them in shape. The sand that is heaped up is mixed with gold. The Indians therefore go to the desert to get this sand, each man having three camels, on either side a male one harnessed to draw by the side, and a female in the middle . . . When the Indians arrive at the spot, having sacks with them, they fill these sacks and return with all possible expedition. For the ants, as the Persians say, immediately discovering them by the smell, pursue them, and they are equalled in swiftness by no other animal, so that if the Indians did not get the start of them, while the ants were assembling, not a man of them could be saved."

This seems a perfectly absurd story, but in one of the publications of the Geological Survey of India, I find the following account.*

'Of the very highest interest are the accounts of the Thibetan gold mines, which are given by the pundits attached to the Indian Survey for the purpose of exploring the countries north of the Himalayas. Unwittingly these admirable native servants of the Government of India have furnished facts which have enabled Sir Henry Rawlinson, and, independently, Professor Frederic Schiern, Professor of History of the University of Copenhagen, to clear up a mystery which has been a puzzle to the historians and philosophers of many countries for upwards of 2000 years. A translation of Professor Schiern's paper, by Anna M. H. Childers will be

found in Vol. IV of the 'Indian Antiquary'. It is a most remarkable example of learned research and one very difficult to give in abstract. It is entitled 'The Tradition of the Gold-digging Ants'. But perhaps before giving the conclusions which Sir Henry Rawlinson and Professor Schiern have arrived at, it will be best in this place to briefly describe the pundits' observations.

"During the expedition of 1867 the pundit who had been at Lassa fell in at Thok Jalung with a large encampment of Thibetan miners, and took the opportunity to gain information relative to the working of the mines. In the third expedition, in 1868, another pundit passed on as far as Rudok, at the north-west extremity of Chinese Thibet on the frontier of Ladak, and on his way back from Rudok he visited the goldfields of Thok Nianmo, Thok Sarlung, and Thok Jalung.† The map which accompanies Major Montgomery's narrative of the journeys of the pundits gives in addition the goldfields of Thok Munnak, Thok Ragyok, Thok Ragung, and Thok Dalung . . . The miners' camp at Thok Jalung, according to the measurement of the pundits, is 16,300 ft. above the sea-level. The cold is intense and the miners in winter are thickly clad with furs.

"The miners do not merely remain underground when at work, but their small black tents, which are made of a felt-like material, manufactured from the hair of the yak, are set in a series of pits, with steps leading down to them . . . seven or eight feet below the surface of the ground . . . Spite of the cold the diggers prefer working in the winter; and the number of their tents, which in the summer amounts to 300, rises to nearly 600 in the winter. They prefer the winter, as the frozen soil then stands well, and is not likely to trouble them much by falling in.

"They are occasionally attacked by robbers, who carry off their gold."

Sir Henry Rawlinson, a noted scholar and the first to decipher the cuneiform inscriptions of Assyria, remarks on these reports of pundits' researches and travels as follows:

"Now for the first time we have an explanation of the circumstances under which so large a quantity of gold is, as is well known to be the case, exported from the west to Khoten, and finds its way into India from Thibet; and it is probable that the search for gold in this region has been going on from a very remote antiquity, since no one can read the ex-pundit's account of Thibetan miners, 'living in tents some seven or eight feet below the surface of the ground, and collecting the excavated earth in heaps previous to washing the gold out of the soil', without being reminded of the description which Herodotus gives of the 'ants in the lands of the Indians bordering on Caspatyrus (or Kashmir) which made their dwellings underground, and threw up sand-heaps as they burrowed, the sand which they threw up being full of gold'."

*A Manual of the Geology of India', Part III, Economic Geology, by V. Ball, Calcutta, 1881, page 213.

†Ball says that the pundit passed a great excavation 30 to 40 ft. deep, 200 ft. wide, and two miles long, from which gold had been extracted.

Professor Schiern points out that the tradition was mentioned in writings of the Middle Ages, and those by Arabian authors. It survived among the Turks. Strabo and Albertus Magnus treated the whole story as a fiction. Xivrey supposed that the animals had become extinct owing to the *auri sacra fames*. Major Rennell supposed that the dwellers in mounds were *termites* or white ants. Humboldt's observations in Mexico on the habits of certain ants to carry about shining particles of hyalith was quoted by those who believed that the animals were really ants. Other authorities suggested that they were marmots, jackals, foxes, or hyenas. Pliny having stated that the horns of the Indian ant were preserved in the temple of Hercules at Erythrae, Samuel Wael, who maintained the hyena theory, proved equal to the difficulty by suggesting that the horns might have been a *lusus naturae*. Professor Schiern ingeniously argues that horns had been taken from the skins of animals that formed the garments of the miners. It seems possible, however, that they were samples of the pickaxes made of sheep's horns, which, as is mentioned above, are used to the present day by the miners in Ladak.

Professor Schiern further points out that ancient writers say that the ants worked chiefly in winter, and connects this with the statement of the pundit above quoted. In conclusion he writes:

"For us the story partakes no longer of the marvelous. The gold-digging ants were originally neither real ants, as the ancients supposed, nor, as many eminent men of learning have supposed, larger animals mistaken for ants on account of their subterranean habits, but men of flesh and blood, and these men Thibetan miners, whose mode of life and dress were in the remotest antiquity, exactly what they are at the present day."

The latest account that I have seen of these goldfields of Tibet is in the appendix to Waddell's 'Lhasa and its Mysteries': he states that the large gold mines undoubtedly exist and extend over 300 miles in one long tract, the principal workings being at Thok Jahung N 32°24', E 81°38'; and in addition to this tract others are known.

W. H. SHOCKLEY.

Palo Alto, April 28.

Prospecting

The Editor:

Sir—Permit me to say a word in behalf of my old pals and myself in reference to prospecting, or rather lack of prospecting, in these times. The scribbler of these lines has spent some 25 years in the field and ought to qualify as the genuine article.

That prospecting as we know it, that is, actually looking for mineral, has narrowed down to the vanishing point cannot be denied. Staking sagebrush claims we have never recognized as prospecting, and that is about all one sees nowadays. Such 'properties' are eagerly sought at times whenever a mushroom boom is started by the professional promoters who issue these worthless stocks to the public, and I am sorry to say that often the

leading business men, bankers, and professional men lend their names as bait, for a block of promotion stock. A glance at the long list of Divide companies and the names of the directors will substantiate my statement. This, in my opinion, is mainly responsible for driving the genuine prospector from the field, because these fake promotions absorb the money that would in part at least go to the man actually digging.

Other causes are hard to define, but it has been almost impossible of late years to interest capital in prospects. Your mahogany-legged engineers seem to expect us to find and turn over to them properties fully developed, which cannot be done by a man working alone and without means. If you would bear in mind that the prospector also must eat, you would not make so many foolish breaks regarding the decline in prospecting.

To sum up briefly, just what is crowding the prospectors slowly but surely out of the field? I will name a few causes: fake mining companies, free option lums, lack of financial support, and last, but not least, the high cost of grub, tools, and powder. Right here I wish to make a plea for my old pals. We are most of us getting on in years and cannot compete with younger men, mostly foreigners, in the mines in earning grubstakes as we used to. What I ask of the fraternity is, if you are taking over a property don't break his heart by insisting on months of waiting for first payment. This often causes real hardship and suffering, too much of which has crept into our lives of late years.

E. M. WEST.

Tonopah, Nevada, April 28.

The Editor:

Sir—I like to read your paper, and note your request to "chip in". Yes, if you will give us prospectors a square deal. I can tell you why we don't open new strikes. First, there is a strip 40 miles wide, and in lots of places 60 miles wide, half of which is owned by the Southern Pacific railroad, two thousand miles long from Cottage Grove, Oregon, to Imperial Valley, California, and more in other States, which means millions of acres or square miles. The Government claims the mineral, because the mineral was not given to the railroad. Congress is 80% lawyers and that strip makes lawsuits. Second, where are the grubstakers? The men that will gamble on a man to find a mine. Gone? Not much! The old storekeeper or the old banker or the saloon-man or hundreds of others, gamblers, farmers, stockmen, livery-stable men that got stuck for meals. No; they are all of them still taking a chance. Where? How?

Now let me tell you. And it don't help you engineers either. Hundreds of you fellows are out of a job because it is so. The men that took a chance in the old days are taking a lot longer chances now, all of them, the little grubstake man and the big one. They buy stocks on margins. They get quick returns. We prospectors are going fast. They make money once in a while but lose more often—sell long or buy short or some way. But where do the engineers get off? and where can a fellow

get a grubstake? Stop the damned stock-gambling. Third, the gold is here. Help stop the curse. They will grubstake all of us that didn't die with the flu. Pass a law so the railroad can get 10% and the Government 5%, and give us a chance at the railroad lands in California, Oregon, Washington, and Idaho.

Stop the gambling that develops nothing and produces nothing but suicides. It is the curse of the age. Stop it!

F. W. WRIGHT.

Los Angeles, April 29.

Mining Opportunities in Northern Mexico

The Editor:

Sir—There are two railroad building projects in Mexico that are of vital importance to the republic, strategically and commercially—strategically for they will serve to unite the capital and the eastern half with the isolated western portion; commercially, for they are vital to the development of the empire of fertile coast plain along the Gulf and along the Pacific and to the mines lying in the Sierra Madre. The Southern Pacific of Mexico, constituting the Mexican connection of the Southern Pacific system, begins at Nogales and taps the most important ports of the west coast of Mexico, runs the entire length of the coastal plain, crosses to connect with the Guadalajara branch of the Mexican Central, and thus finds ingress to the national capital. This railroad will stand as a monument to the energy and foresight of Epes Randolph, who, through revolution, flood, fire, Indian warfare, and world-war conditions, has pushed the construction of this great line of commerce. When completed it will compare, not unfavorably, with the achievement of James J. Hill in the north. It forms the main link in the Panama-California line, which is now no longer a dream; it might be a link in an Alaska-Vancouver railway.

The other important line is the Kansas City, Mexico & Orient, from Kansas City to Topolobampo. This line lacks a short stretch between Creel, Chihuahua, and Fuerte, Sinaloa. There are many mines along this route that have been famous for centuries; many new discoveries await the incoming of capital which is now gaining confidence in the ability of President Obregon to bring Mexico back to stability and reason. The early resumption of the construction of this line is said to be assured, and when work is begun, the boom that will come to the districts near the Sonora-Sinaloa-Chihuahua corner will be notable. Many companies that now struggle with the hard problem of pack-saddle transportation, inspired by the possession of large bodies of rich ore, will come into bonanza when this line comes to their relief. The El Fuerte Mining & Smelting Co., in Sinaloa, has a cluster of immense orebodies carrying gold, silver, and copper, within reach of the smelting plant now being installed at the Mesa Colorado on the Fuerte river.

The Lluvia de Oro mine lies a little farther to the east, higher in the main backbone, and has produced gold for years. The Aguila company, owned principally by Kansas men and fathered by W. H. Seamon, of El Paso,

is about to pack in heavy machinery, as did the Lluvia company. The famous old 'Boss' Shepherd mines of Batopilas, the *antiguas* in and around Urique, and countless others, lie in this great mineral belt; the man who does not mind roughing it cannot fail to secure possession of attractive properties to offer the Pullman traveler, who will soon be able to come to this field. The present low ebb on the metal market may serve to check temporarily the ardor of mining investors, but those who fail to cast their eyes about, when faint-hearted ones hesitate, often lose opportunities to secure ground-floor chances. One of the world's greatest mining fields lies almost at our very doors, in the Sierra Madre country of northern Mexico.

HORACE LOOMIS.

Choix, Mexico, March 8.

Slosson's 'Creative Chemistry'

The Editor:

Sir—Your editorial note on Dr. E. E. Slosson's 'Creative Chemistry' in your issue of April 23 is properly appreciative, and I agree that it is the kind of popular scientific book that Huxley would have liked to read. But Mr. A. W. Allen's long review in the same issue would give a reader a different idea of the book; he picks all manner of flaws in it, and says little of the virtues, which are overwhelmingly more important than the flaws. That sort of book-review is all too common in American periodicals. Such a reviewer disregards the outstanding importance of a really valuable new book and sets forth unrepresentative details on which he can hang his own hobbies. Naturally when an author daringly and commendably gives to the public a much-needed synthesis of recent knowledge, he cannot get everything exactly in the proportion and aspect to please everybody. Learning has become so subdivided and its parts so specialized that it becomes increasingly difficult for an author to make a readable synthesis of facts on any broad subject; and for the same reason it becomes increasingly easy for a specialized critic to pick flaws in a technical book that appeals to the public.

When I get hold of a book like Slosson's 'Creative Chemistry', or Wells' 'Outline of History'—with all its faults—I feel like singing a paean of praise to the author. Then when I read reviews of the book by specialists who misrepresent it in their zeal for disputing incidental points that have caught their eagle eye, I think of Carlyle's sarcasm about the "critic fly" on a "brave stately building" and how it declared "with its half-inch vision, that here is a speck, and there an inequality; that, in fact, this and the other individual stone are nowise as they should be". The same keen-worded Scotsman remarked further that if 'Oedipus Tyrannus' were now discovered and staged for the first time, the critics would have their column of flaws to enumerate. "Was not the whole affair rather 'heavy'? . . . Did not Oedipus somewhat remind us of a blubbery school-boy, and Joeast of a decayed milliner? . . . And so on, through all the variations of the critical cornpipe". Few great

authors are as omniscient as their critics. For instance, Nicolaus Copernicus' 'De Revolutionibus Orbium Caelestium', published in 1543, kept to the old Greek assumption of uniform circular motion of the planets, necessitating an elaborate system of epicycles. This whole detail was wrong, yet the book of the Polish canon of Franenburg has been of the greatest value to the world, and is important for the statement of the heliocentric theory regardless of minor errors.

While speaking of book-reviewing, I recall recently reading an interesting letter to the editor of some periodical (possibly the Literary Review of the New York 'Evening Post') in which a librarian ranked the reviews in the British weekly 'Nature' as the best he knew of. These reviews tell what the book is about, how it treats the subject—popularly or technically—and what special offering of material or method the author brings. Such information is what the reader usually wants. Unfortunately too many reviews have to be painfully puzzled over before the reader can obtain this information, for reviewers like to miss the main point for the sake of jumping on incidental slips. "In this way", said Carlyle, "does the small Reviewer triumph over the great Authors".

P. B. McDONALD.

New York University, April 26.

Book-Reviewing

The Editor:

Sir—Mr. P. B. McDonald's comments on book-reviewing, with especial reference to my review of Dr. Slosson's 'Creative Chemistry', are inaccurate and contradictory. He is inaccurate in stating that in the review I said little about the virtues of the book; he is inconsistent in advocating a system of book-reviewing that would practically confine the reviewer to making a résumé of the book, and that, in the present instance, would have prevented me from stating "the author, who is a chemist as well as an editor, is to be congratulated on the appearance of an excellently written, well-edited, and informative treatise" and from acclaiming 'Creative Chemistry' as a book that "will . . . take its place among serious efforts to enlighten and educate the average man on the progress of the art, and the achievements of chemical specialists"; it would have been impossible for me to have drawn attention to the fact that "the industry is fortunate in being able to call on writers like Slosson and Hendrick, both of whom possess the knowledge, as well as the happy knack, of being able to impart it in an entertaining manner"; I should have refrained from reference to what I considered as "the generosity of the author, as well as the catholicity of his views"; and, in anticipation of Mr. McDonald's ideas on reviewing, I should not have stated that 'Creative Chemistry' "prompts the reader to think. It is educational and written in a delightful style".

Mr. McDonald tells us that when he gets hold of a book like 'Creative Chemistry' he feels like giving a paean of praise to the author. Such an attitude, how-

ever, is likely to result in an unbalanced review. The critic is too often carried away by his enthusiasm under such circumstances, as Mr. McDonald was when he reviewed 'Creative Chemistry' a little while ago in the columns of 'Engineering and Contracting', in which he credited the chemists with the production of guayule rubber as a synthetic achievement, and emphasized, by repetition, Dr. Slosson's mistake of referring to the new chromium-steel alloy, used largely during the War for aeroplane valves and applicable to many other phases of engineering work, as "stainless cutlery". My impression is that authors of note, like Dr. Slosson, would not welcome a review of this kind, as compared with one in which a frank tribute is paid to the ability of the author and the merits of his book, coupled with a constructive criticism of what, in the reviewer's opinion, should receive attention before the next edition is published. Mr. McDonald favors the non-critical review in the same communication in which he refers to 'Creative Chemistry' "with all its faults"; and yet his own published review of the book makes no mention of these faults, but, on the other hand, is fulsome with critical appreciation.

I question Mr. McDonald's estimate of criticism in the United States; to me it appears to be almost as extinct as the dodo; it isn't done. Unworthy books appear and meet with a reception that is neither hot nor cold; new issues of excellent treatises are published in which the mistakes in the first edition have not been corrected; papers galore are presented at meetings of technical societies that fail to elicit either criticism or discussion; it simply isn't done. The fact that adverse comment may be made in an entirely friendly way is recognized only by an insignificant minority; by far the greater proportion of people consider that a fair and just criticism is to be interpreted as a personal affront—an act of ill-will, rather than, as it should be interpreted, as an evidence of intelligent interest and a desire to assist in strengthening that foundation of truth on which all real knowledge rests.

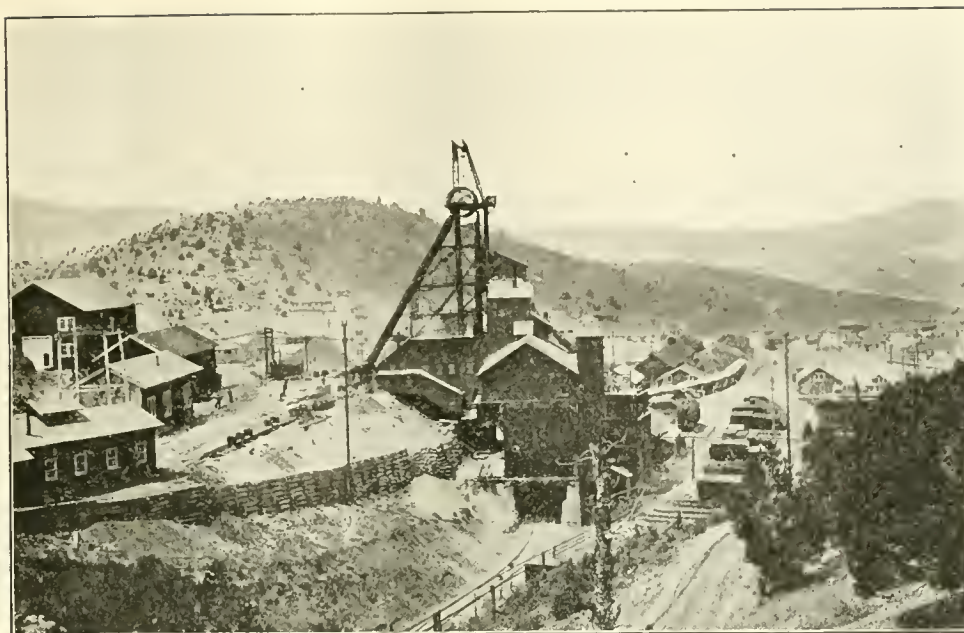
A. W. ALLEN.

San Francisco, May 6.

A HIGH-GRADE NICKEL ORE has been found close to the tale mines, north of the branch line to Barberton, Transvaal, South Africa. A. F. Crosse, in a recent issue of the 'Journal' of the Chemical, Metallurgical, and Mining Society of South Africa, describes the ore as a new and undescribed mineral. An analysis gave:

	%
Oxide of nickel	40.30
Oxide of iron	49.30
Phosphorus	0.13
Calcium oxide	0.20
Silica	6.50
Loss on ignition, chiefly water	2.15
Loss	1.45
Metallic nickel	29.6
Metallic iron	35.7
Platinum	0.2 dwt. per ton

A bar of nickeliferous iron, which was smelted direct from the ore, assayed 25% nickel.



THE STAR POINTER SHAFT

Nevada Consolidated Mining Company—III

Underground Mining at Ruth

By Arthur B. Parsons

INTRODUCTION. The thickness of the leached cap that overlies the ore deposit in the Ruth mine of the Nevada Consolidated company varies from 110 to 540 ft. and averages more than 410 ft. In lateral extent it is approximately 1600 by 1200 ft. and it is roughly oval in shape. As delineated by systematic churn-drilling, the thickness of the greater part of the ore-zone ranges from 40 to 310 ft., with an average of 120 ft. The ore is of comparatively uniform grade; and the ore and cap-rock alike are unusually soft; accordingly it was evident at the outset that some method of caving would be used for mining the ore.

The outstanding feature of the underground mining is the evolution of the branch-raise caving system now employed with exceptional success. Credit for the satisfactory results is due largely to W. S. Larsh, the present superintendent of underground mining operations, who introduced the system in 1915 and who has had immediate supervision of the work since that time. In initiating the work Mr. Larsh had the assistance of Robert Marsh Jr., who was general mine superintendent in 1915, and he has always enjoyed the invaluable advice and hearty encouragement of C. B. Lakenan, general manager for the company. Mr. Larsh, himself, is unstinting in the credit he gives to the members of his staff for their assistance in working out details of the

scheme of procedure and in conducting current operations. The development of the method will be discussed under four heads as follows: (1) the attempt to use the Ray system of shrinkage-stope and pillar-caving, and the reasons for its abandonment; (2) the adoption of the branch-raise system and an outline of the ideal procedure; (3) the method of regulating and recording the 'draw', that is, the removal of the ore from the different chutes tapping a block of ore; and (4) the application of the system or method to the mining of the entire orebody.

THE RAY SYSTEM. This is the method used successfully in the Ray Consolidated mine at Ray, Arizona. During the latter half of 1915, when production from the Ruth mine commenced, and for part of 1916, this plan was tried on a block of ground above the 300-ft. level from the Ruth inclined shaft. Following the Ray method, a series of long narrow stopes 10 to 15 ft. wide was completed at 25-ft. centres, thereby leaving a corresponding series of pillars having approximately the same width as the stopes. As soon as the stopes had reached the upper limit of the ore, the pillars were blasted from beneath; when the ground caved, the worthless overburden was allowed to follow the ore as it was drawn off below. The working-level from which the mining was done was a sub-level 30 ft. above the main motor-haulage drifts. On the sub-levels the ore was trammed by hand

in drifts spaced at intervals of 25 ft. and running at right angles to the long dimension of the shrinkage stopes and also to the main haulage-passages on the level below, with which connection was made by chute-raises and manway-raises at frequent intervals.

However, the ground in the Ruth mine proved to be 'weaker' than had been expected and the expense involved in keeping open the hand tramming drifts on the sub-level was great. It was necessary to replace timbers frequently, thereby increasing the cost of labor excessively. On the other hand, it was observed that the haulage-drifts, although they had to be closely and strongly timbered, were far enough below the zone of active mining to escape, or at least to withstand, the shifting pressure. Using the Ray system it would, of course, be possible to have placed the principle haulage-ways at a greater distance below the working-drifts; but this would not have obviated the great expense of keeping the latter open. It appeared on the other hand that the vertical and inclined openings were maintained without unreasonable expense; accordingly a practicable plan was sought for doing away with the intermediate levels by the substitution of a greater number of raised connections. The development of the present system and the abandonment of the attempt to use the Ray method ensued.

THE BRANCH-RAISE SYSTEM. The scheme for attacking an ideal block of ore, the bottom of which is assumed to be a horizontal plane, is illustrated in Fig. 1.* The haulage-way at the bottom is one of a number of parallel drifts driven at intervals of $87\frac{1}{2}$ ft., the track-level being 60 ft. below the bottom of the orebody. In actual practice the distance between the haulage-level and the 'point of draw' ranges between 40 and 80 ft., but 60 ft. is standard. Calculations based on the estimated cost of drifting and raising on an angle of 50° with the horizontal showed that with respect to the cost of driving the necessary working-openings the most economical distance between the haulage-drift and the bottom of the mining-zone was 40 ft. It was decided, however, that the horizontal pillar intervening between the top of the drift and the draw-level, if 40 ft. were selected as the standard height, would be so thin as to necessitate additional expense for maintenance. Calculations for 50, 60, 70, and 80 ft. showed that 60 ft. required less expenditure for making the necessary openings than any of the others, and it was accordingly adopted as the standard.

It should be explained that the angle of the branch raises, 50° , is the first factor determined; it is fixed and the distance between the main motor-haulage drifts and the vertical distance between the drifts and the draw-level are adjusted to meet this requirement. In a chute that is too steep, soft ore has a tendency to pack and cement itself in huge masses that must be broken by blasting or by expensive work with bars; or it may arch in the chute. On the other hand if the slope is not great enough the ore 'hangs up' and must be helped along con-

tinually, this tendency being exaggerated with soft ore such as is handled in the Ruth mine. The most advantageous angle has been proved to be 50° ; and so important is this question of slope that no deviation is permitted.

The ideal measurements accordingly are $87\frac{1}{2}$ -ft. intervals between haulage-drifts and the 60-ft. distance between haulage and draw-levels, thereby permitting the branch raises to slope at 50° , as shown in the figure. A 'raise-series', as the set of branches shown in section A.A., Fig. 1, is called, is started at intervals of 25 ft. along the direction of the main haulage-drifts. Special timbering, termed a 'pony-set', Fig. 2, provides a chute and an aregate on each side of the drift. The branches are raised and timbered with 4 by 12-in. or 6 by 12-in. cribbing, the selection depending upon the character of the ground. Each raise has a chute-compartment 3 by 4 ft., inside dimensions, and a manway 2 by 3 ft. At the top of each branch, immediately over the chute-compartment, is a vertical square-set framed of 10 by 12-in. or 12 by 12-in. timbers. From this set are built two cribbed finger-raises, as shown in detail in Fig. 3, and diagrammatically in Fig. 1. These fingers, according to the early practice, consisted of four or five sets of cribbing, but this was found to be too much. Three sets at a somewhat lower pitch afford the necessary spread and make work more convenient for the miner who is drawing ore.

It is apparent that the centres of adjacent square-sets are $12\frac{1}{2}$ ft. apart in the plane of each raise-series. Since the finger-raises diverge in planes at right angles to this, the result is a checkerboard arrangement of draw-points, formed by the finger-raises, spaced $12\frac{1}{2}$ ft. in both directions. The imaginary plane, which is the locus of the draw-points, is known as the draw-level; theoretically it coincides with the bottom of the ore deposit.

Three or four raise-series are completed before drawing can be started in a particular block; the succeeding series are 'brought in' consecutively, one at a time, the rate depending upon the demand for ore-production. It is not desirable that the development by raises should be far in advance of actual mining because of the cost of maintaining the raises. As mining operations advance the ore is under-cut by miners working in the finger-raises, the amount of such work depending upon the local nature of the ground. The attempt is always made to connect all the finger-raises in each row of the series and to run cross-cuts between alternate fingers of the two rows, as shown in Fig. 1. This leaves a row of narrow pillars to be drilled and blasted as the final step in completing the under-cut, over a given raise-series; it is always best to under-cut completely in order to assure uniform caving. Unless a new block is being started there is the shattered ore overlying the previous raise-series to which cross-cuts may be run and to which the remaining pillars can break. In some parts of the mine it is frequently necessary to stop 15 or 20 ft. above the draw-level in order to start caving; on the other hand, the ground may be so greatly shattered that it is impossible to complete the under-cut, and a dozen long holes,

*After Walter S. Larsh. Trans. A. I. M. E. Vol. LIX. Page 299.

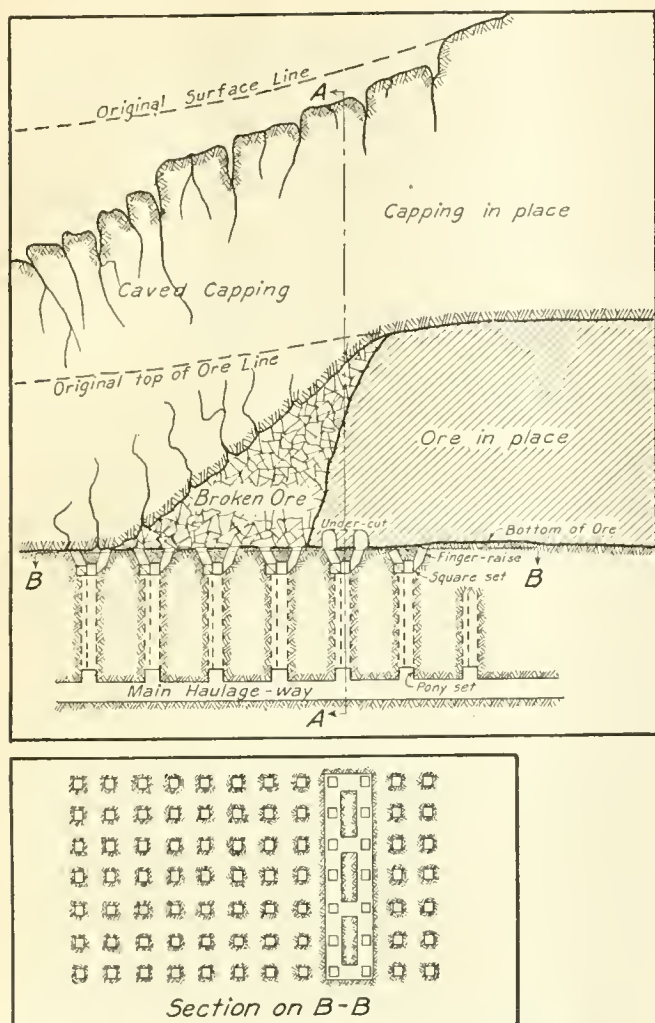


FIG. 1. SKETCH SHOWING IDEAL CAVING OPERATIONS

drilled from the 'fingers' and fired simultaneously, start the caving satisfactorily.

Occasionally blocks covering an area of several hundred square feet settle without breaking. These obviously must be broken up before the drawing can proceed properly; a small stope started within the huge piece has frequently served as the best way to break it up. In general, however, according to Irving Van Dalsem, the energetic chief engineer of the Ruth mine, to whom I am indebted for my information concerning many details of the operation, the caving of Ruth ore is not a difficult part of the problem. Moreover, it is characteristic of the cap-rock that it caves readily and follows the ore uniformly. This is one of the essential characteristics of a deposit that can be mined successfully by any caving method. Incidentally, it may be pointed out that this system of mining probably could not be used advantageously at Ray for the reason that the orebody there is so solid that it could not be depended upon to cave, without the weakening effected by shrinkage stopes. On the other hand, there is nothing inherent in the nature of the Nevada Consolidated orebody to prevent the successful use of the Ray method; the question is simply one of comparative cost.

REGULATING AND RECORDING THE DRAW. Good results

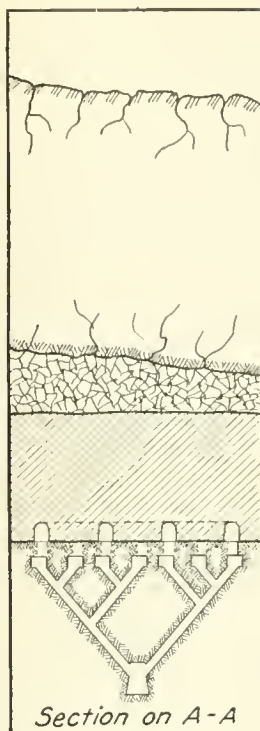


FIG. 2. A PONY-SET AND ORE-CHUTES

depend entirely on the care with which the ore is drawn from the different finger-raises. Both Mr. Lakenan and Mr. Larsh are emphatic in declaring that inattention to this feature has been the cause for unsatisfactory results in nearly every instance where branch-raise mining has been tried without entire success. Two things are sought: first, to get all the ore; second, to leave all the cap-rock, which, of course, tends to mix with the ore, which it follows down. The only way by which an idea of the condition of the caved mass of ore and waste can be obtained is by keeping a detailed record of the ore taken from the stope at each draw-point, and by checking this against the 'expectancy' from that point.

The expectancy, that is, the quantity and grade of ore that should be recovered from a given finger, is calculated from data obtained in churn-drilling, close approximation being possible because of the absence of wide or sudden fluctuations in the tenor of the ore. Sundry charts are made to record the estimates thus obtained and finally the information is displayed graphically on a simple but ingenious model. This consists of a group of perpendicular steel rods about 3 ft. high and $\frac{1}{8}$ in. diameter fixed in holes in a large wooden base, the surface of which is laid out to scale to represent a block of ore being mined. Each rod is situated at a draw-point. On the rod is an adjustable collar that can be slipped up or down and fastened in any desired position by means of a small set-screw. At the start the

expectancy data are used to determine the height of the individual rods, the tops of which represent the position of the plan of separation between the cap and the ore-body.

A daily report is made showing the quantity of ore drawn from each raise by the motor-men, together with an estimate by the draw-bosses of the amount taken from each finger. The stope-engineers adjust any discrepancies in the figures and credit the draw-points with proportional parts of the total reported by the motor-men. Daily samples are taken of the ore from each raise-series

and assay reports, and in diagnosing difficulties, much of this work falling to J. P. Caulfield Jr., the foreman. By temporarily stopping or decreasing the quantity taken from certain draw-points and increasing that from others they are able to control the operation with remarkable success. It is desirable to draw slowly from a comparatively large area, rather than to remove narrow blocks by hurried drawing.

The following data are typical records from the monthly report. It will be observed that the draw from Raise No. 22½ has been completed.

Level 500, Block 1. Month of December 1917

Raise No.	Expectancy		Reserve Dec. 1, 1917		Ore extracted		Reserve Jan. 1, 1918		Total extracted	
	tons	grade, %	tons	grade, %	tons	grade, %	tons	grade, %	tons	grade, %
22½	34,127	2.25	2,339	2.25	3,320	1.79	...	...	35,108	2.10
22¾	39,904	2.20	14,107	2.20	6,821	1.64	7,286	2.20	32,678	2.09
23½	38,284	2.31	21,160	2.31	11,401	1.82	9,759	2.31	28,525	2.08

and, in the event of unusual behavior, from individual fingers. These assays, of which an average of 100 is taken each day, are combined with the figures on tonnage, and, after the charts are brought up to date, the information is transferred to the model, that is, the colars are lowered by the amount represented by the ore drawn. There will be irregularities, of course, but the result is a fairly reliable graphic record of the current position of the top of the eaved ore. The stope-engineers prepare a sheet every evening for the foremen, showing the quantity that should be drawn from each finger next day. The system of recording was devised by Mr. Larsh and his assistants, and is credited by him as being the principal factor in the success of operations.

The 'angle of draw' is the slope, from the horizontal, of the plane of contact between broken ore and waste in the direction of successive raise-series. Experience has shown that this angle should be maintained at approximately 40° for the best results. If this angle be steeper, the difficulty of preventing the admixture of waste rock is increased, whereas if it be less steep, a longer period will elapse from the time a block is started until it is finished. This entails extra expense in keeping the raises open and the timber in repair. There is the disadvantage of having an excessive quantity of ore broken in advance; it tends to pack tightly and must be loosened again. In the other direction, that is, in the direction of the successive fingers from the same raise, the contact-plane is, in general, kept horizontal.

'Contact-plane' suggests a smooth surface dividing the ore and waste. In practice the maintenance of such a plane is impossible, as can readily be imagined: the purpose of regulating the draw is to approach such a condition as nearly as possible. Tongues of ore will reach up into the cap-rock and may be lost; on the other hand, channels may form so that cap-rock gets down to a particular draw-point long before the expectancy from that point has been realized. Occasionally an arch will form over a finger and cannot be blasted, so that drawing from this point will necessarily be delayed. The remedy is to attack the 'choke' from adjacent fingers by blasting the large pieces that cause the trouble. Mr. Larsh and his staff have become adepts at interpreting the daily draw

An idea of the final result may be obtained from the following figures covering all portions of the orebody that had been completely mined at the conclusion of the year 1920.

Expectancy		Actual recovery		Excess of		Deficit of	
tons	copper, %	tons	copper, %	tons, %		tons, %	
3,580,757	2.15	3,747,249	1.95	46		49	

These figures do not show the tonnage shipped up to that time, for the reason that blocks that were only partly mined are excluded from the calculation. They indicate, however, that excellent results are being obtained. The admixture of waste in the ore shipped amounts to 9.1%; of this, 95% is virtually barren, the cap in the Ruth mine differing in this respect from that at Ray, Inspiration, and Miami, where most of the cap-rock contains appreciable amounts of copper. The high net recovery made by the Nevada Consolidated therefore is particularly meritorious.

APPLICATION OF THE BRANCH-RAISE SYSTEM. The orebody, speaking generally, is lenticular in shape with a dip of 15° to the north-west. However, the limits of the minable ore are irregular in both vertical and horizontal directions, thereby presenting sundry interesting problems in planning the details of mining. The general scheme is to place the drifts from which the branch raises start in such a manner that the draw-level, 60 ft. above, will coincide everywhere with the bottom of the ore. This height varies between the limits of 40 and 80 ft., but, as stated before, the standard is 60 ft. The interval between the levels must, to correspond, be 60 ft. On each level a principal haulage-way is driven from the Star Pointer shaft to the theatre of actual mining; at right angles to it are the various working-drifts, which follow roughly the contour of the bottom of the orebody. On the 6th level, for instance, these drifts are straight for about 700 ft., beyond which point they make a wide curve and run off at an angle of 75°. The working-drifts are never vertically above or below those on the next adjacent level. One series of drifts on the 5th level is in ore that extends down to the 6th level as a sort of sag in the lower limit of the orebody. This will be mined from the 7th level, making a 'lift' (referring to the height of the block of ore mined) of 210 ft., the maximum that

will be necessary according to present plans. The timber in the drifts on the 5th level and in the branch raises above will mingle with the ore when this block of ground is being mined. How much trouble will be caused by its presence remains to be seen; doubtless to some extent it will obstruct uniform drawing. The 5th-level drifts were

ft., even though a completely new start could be made, the fact remains that when the present system was adopted it was necessary to make the best use possible of a large number of unsuitably placed drifts. The present plan provides for an 8th and a 9th level, from each of which approximately 3,000,000 tons will be mined. Recent

drill-holes indicate the probability of still deeper ore, but, according to Mr. Larsh, there are not enough data available to determine how much deeper it will be necessary to go in order to mine all the ore.

An interesting detail is illustrated in Fig. 4, which shows a number of special branches devised for recovering blocks of ore around the edges of the main body and in places where the shape of the enriched part of the deposit is irregular. Experience has proved that a steep angle made by the successive branches from the same raise is to be avoided. It seems that the caved material is likely to carry the timbers of the upper fingers down to the lower draw-points, with dire results so far as the successful drawing of the ore is

concerned. Where the lower boundary of a block of ore is particularly steep a compromise is made as in Fig. 4, where some of the ore is sacrificed and some waste is taken. These diagrams are used by the miners under-

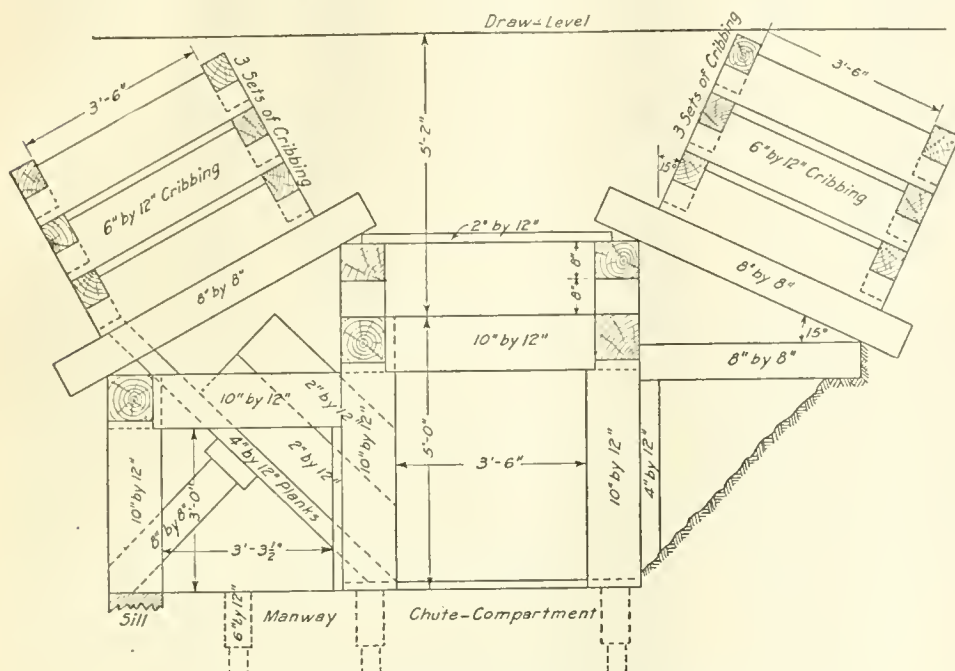


FIG. 3. THE TIMBERING OF THE FINGER-RAISES

run in 1908 and 1909, before any definite conclusion had been reached as to the method of mining to be used, further than that some system of eaving must necessarily be devised. If the work were to be done over, in the light of present knowledge of the orebody and of the method of mining, the 5th level would not be opened as it was. In-

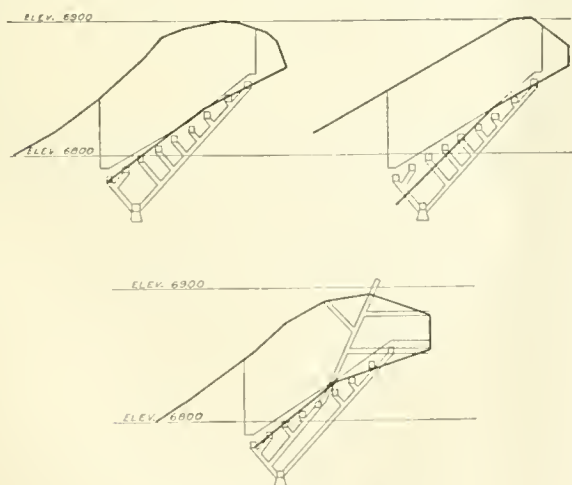


FIG. 4. SPECIAL BRANCHES

stead the entire system of haulage-ways would be arranged to provide for the mining of every part of the orebody in single lifts, the maximum thickness, 310 ft., being ideal for removal of the ore by the branch-raise method. Although the shape of the deposit is such that the average lift would necessarily be much less than 300

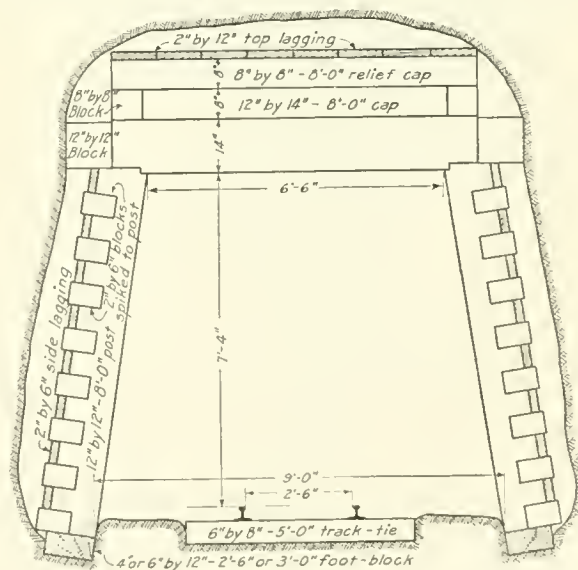


FIG. 5. A DRIFT-SET

ground to point their raises as well as by the stope-engineers for their office-work.

The air-drills used in drifting are Ingersoll-Rand '18a' and '24S' water-Leynors and Waugh Turbros; in raising, Waugh '16-V' stopers and B. C. R. W. 430 Jackhamers are both used; for sinking, a water-drill, No. 50 Waugh

TABLE I
Ruth Mine. Summary of Development and Stopping Operations During the Year 1920

	Development	Branch-rates and sub-levels	5th level mining	6th level mining	Total porphyry mining	7th level square-set	Total Ruth mine
Feet of development work driven	2,050	14,814			17,770		17,790
Tons of material mined	25,100	40,706	107,710	017,284	850,003	1,282	852,185
Tons material mined per foot of advance	8.52	2.75					
Total feet of hole drilled	30,774	80,400	19,099	50,004	198,024	515	107,130
Total machine-drill shifts	495	1,209	315	850	2,809	8	2,877
Feet of hole drilled per machine-drill shift	80.35	66.50	62.55	60.05	68.55	64.30	68.55
Tons mined per machine-drill shift	50.90	33.65	533.00	726.00	290.50	100.50	290.20
Tons mined per foot of hole drilled	0.03	0.51	8.51	10.89	4.33	2.40	4.33
Total pounds of powder used	10,000	30,000	19,200	80,150	105,150	250	105,400
Feet of advance per pound of powder	0.148	0.401					
Tons mined per pound of powder	1.20	1.10	8.74	0.93	5.16	5.13	5.15
Total board feet of timber used	301,400	1,575,537	05,312	1,073,133	3,105,151	30,433	3,135,884
Feet of advance per 1000 lbs. ft. of timber	8.19	9.40					
Tons mined per 1000 lbs. ft. of timber	60.05	25.82	1,700.00	575.00	274.00	42.15	272.00
Thousands of cubic feet air used	106,800	111,830	152,587	308,153	709,400	250	709,710
Thousands of cubic feet of air per foot of advance	50.20	9.58					
Total man-shifts	8,077.2	15,459.2	9,215.5	17,573.2	80,025.3	602.0	81,527.3
Feet of advance per man-shift	0.341	0.96					
Tons mined per man-shift	2.00	2.63	18.22	12.07	10.52	2.13	10.46

Clipper, has preference. Hercules explosives are used exclusively, 95% of the total being 30% dynamite and the remainder 40%.

Table No. 1 summarizes the results of development and stopping operations during the year 1920. On account of the softness of the ore, drilling is an item of less relative importance than usual. The principal indexes to efficient work are the tons mined per pound of powder, the tons mined per board-foot of timber, and the tons mined per man-shift.

HAULAGE. The Star Pointer shaft, through which the hoisting is done, is 200 ft. west of the scene of actual mining. The position of this shaft was determined by the contour of the surrounding hills, which prevented the convenient extension of the standard-gauge railroad tracks to a point nearer the orebody. Long straight cross-cuts serve for motor-haulage from the drifts to the ore-pockets at the shaft. The cross-cuts are timbered with drift-sets consisting of 12 by 12-in. posts and 12 by 14-in. caps. An additional short false set with an 8 by 8-in. cap supports the lagging as shown in Fig. 5.

An interesting detail is the 'laced' lagging used on the sides of the cross-cuts. Short blocks of 2 by 6-in. wood are spiked to the sides of the posts with a six-inch interval between. They project three inches behind the post and thus support horizontal side-lagging made of 2 by 6-in. material, at the same time keeping the pieces spaced after the fashion of a rail-fence. The spaces are then filled with short thin strips placed vertically. These strips prevent slaked rock from continually dropping off, and in so doing keep the cross-cut clean; at the same time effecting appreciable economy in the cost of timber for lagging. The height of the drifts is 7 ft. 4 in. in the clear; they are 6 ft. 6 in. wide at the top, and 9 ft. at the bottom; the track is of 2 ft. 6 in. gauge with 40-lb. rails. The grade is $\frac{1}{2}$ of 1% in favor of the loaded trains, giving, theoretically, the same traction whether the motor is outward bound with a load, or returning from the station with a train of empty cars.

The equipment comprises eight 10-ton trolley-locomotives. Four are equipped with two 30-hp. Westinghouse, Class 59 motors; each of the others is provided with two 45-hp. General Electric motors, all with series-parallel type controllers operating on a 250-v. D. C.

line. All the locomotives are provided with Westinghouse D-4 mine-trolleys No. 1800; the General Electric motor-armatures are equipped with special ball-bearings, whereas the others have the usual habbitted bearings.

Tracks are maintained in first-class condition and the locomotives pull trains of 18 to 20 cars regularly. These cars are built entirely of steel with a capacity of 88 cu. ft.; they have gabled bottoms, and dump from both sides. They are provided with coiled springs over the journals, and on the couplers. It has been found that these refinements in construction have added materially to the life of the cars and to the efficiency of operation.

The accompanying figures, Table II, summarize the motor-haulage during the year 1920.

TABLE II
Ruth Mine. Summary of Motor-Haulage During the Year 1920

Tons of ore trammed	818,791.0
Tons of waste trammed	33,335.0
Total tons of material trammed	852,185.0
Total train-trips	13,630.0
Tons of ore trammed per train-trip	60.1
Man-shifts on operation	0,921.7
Man-shifts on track-repairs	1,528.7
Tons of material trammed per man-shift (operation)	123.0
Tons of material trammed per man-shift (track-repairs)	557.5
Total man-shifts on tramping	9,754.2
Tons of material trammed per total man-shift on tram	87.4
Motor-shifts	1,606.0
Tons per motor-shift	511.0
Average length of tram in feet	2,850.0

HOISTING. At the present time all loading in the shaft is done from the skip-chute below the 7th level, although most of the ore comes from the 5th and 6th levels. On account of the short lift between levels, the construction of skip-chutes for each level was inadvisable as it would have weakened the shaft seriously. Accordingly the ore-pocket below the 6th level was built with its centre 35 ft. behind the centre of the shaft and 12 ft. behind the centre of the pocket, or skip-chute, below the 7th level. The bin proper is 10 by 20 ft. and 17 ft. deep inside dimensions, with a hoppers bottom funneling into a cribbed raise 4 by 6 ft. in cross-section on an incline of 55°. A gate, operated by an air-cylinder, controls the flow of the ore into the 7th-level skip-pocket. The cylinder is below the bottom of the spout and the gate cuts off the stream of ore from beneath instead of from above. This detail of design is found generally in the mine; even where the cylinder must be above the chute; in that event the gate is operated in the same manner by the use of a yoke that spans the spout.

Below the 7th-level skip-chute is a measuring-pocket designed to hold six tons, the capacity of the skips. There are, in fact, two measuring-pockets, one for each of the two skip-compartments in the shaft. The distance from the top of the 8th-level station to the lip of the loading-chute is about 5 feet.

One from the 5th level passes to the 7th by way of the ore-pocket on the 6th, so that all of the loading is done through the measuring-bin at the lower level. The whole arrangement, shown in Fig. 6, works smoothly and efficiently and 6000 tons per day could be loaded easily. During 1918 approximately 3650 tons per day was hoisted but this did not begin to measure the capacity of the loading or hoisting arrangements. It will be observed that a somewhat similar arrangement on the opposite side of the shaft serves to collect the waste from the sixth level in the pocket below the seventh from which it may be loaded into the skip.

In addition to two compartments for the 6-ton steel skips, the shaft has two ladder-ways and a cage-compartment, used for hoisting and lowering men and supplies. The three larger divisions are 5 ft. 6 in. by 6 ft. in the clear. Ordinary shaft-sets, the principal members being of 12 by 12 timber, are spaced at 4-ft. centres.

The steel head-frame was erected in 1908 by the Minneapolis Steel & Machinery Co. It is 77 ft. high. Recently the ordinary cast-iron sheaves have been replaced with those of the bicycle type mounted on a shaft of 8-in. diameter. The vibration at the hub is decreased and the sheave-shaft lasts longer.

The ore-bin with a capacity of 2000 tons spans the railroad track, which parallels its length, as may be seen in the accompanying illustration. The original plan provided for sizing the ore prior to shipment to the concentrator at McGill; with this end in view a grizzly with bars spaced one inch was placed at the top of the head-frame. The skips dumped on this grizzly; the fine material was delivered to the central compartments of the bin, while the coarser portion followed inclined chutes to either end of the bin. The scheme was to load the fine product in separate cars and avoid sending it through the coarse-crushing plant at McGill. This idea was abandoned, but the grizzly serves a useful purpose in that the oversize material requires considerably less grade than would run-of-mine ore. As a consequence the ore can be distributed to the extreme ends of the exceptionally long bin, by gravity, without mechanical assistance.

In June 1918 a new electric hoist was installed to operate the skips. This is a double-drum heavy-duty geared machine made by the Nordberg company. Six-ton skips are pulled, in or out of balance, with a rope-speed of 800 ft. per minute. A 1½-in. 6-strand 19-wire plow-steel Roebling cable is employed.

The hoist is connected through herringbone gears to a 400-hp. Westinghouse phase-wound motor operating on a three-phase 60-cycle 550-volt line. Clutches and brakes are controlled by oil, and Welsh safety-stops for over-wind and over-speed are provided.

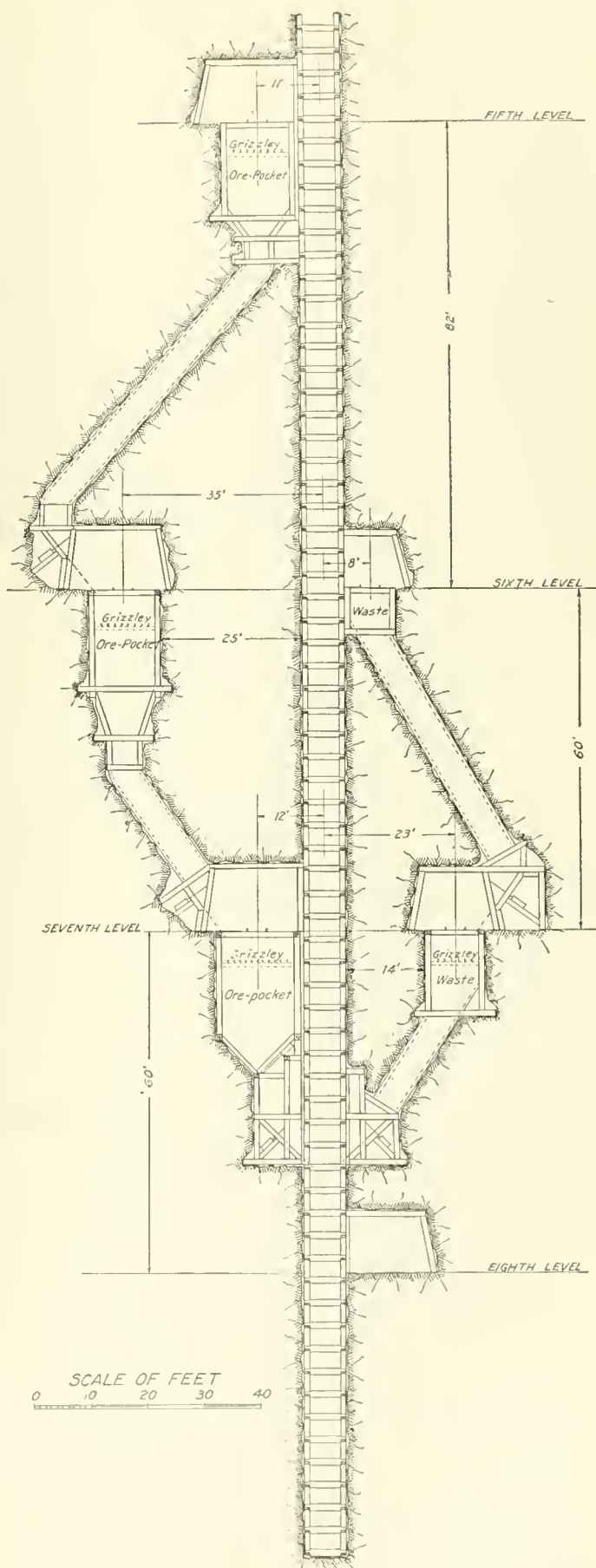


FIG. 6. ARRANGEMENT OF ORE-POCKETS AT THE STAR
POINTER SHAFT

A summary of hoisting operations for the year 1920 follows:

TABLE III

Ruth Mine, Summary of Hoisting Operations During 1920	
Skips of ore hoisted	147,871 0
Skips of waste hoisted	5,087 0
Cages of timber hauled	3,179 0
Cages of men hauled	10,921 0
Total dry tons of ore hoisted	818,791 0
Total tons of waste hoisted	33,335 0
Total tons of material hoisted	852,126 0
Total man-shifts	0,000 0
Tons of material hoisted per man-shift	128 9
Average number of dry tons per skip	5 94
Average distance hoisted, feet	010 0
Average time of skip in minutes	1 20

Two machines that give especially good satisfaction are the compressors. Over a period of one month they produced at the rate of 1000 cu. ft. of air per minute with an input of 2.04 kw-hr. as compared with the manufacturer's guarantee of 2.25 kw-hr. This particular record is exceptional, but the performance is consistently good. The compressors are manufactured by the Ingersoll-Rand Co.; they are type P.R.E. 2-stage machines, fitted with Ingersoll-Roegler valves and rated to compress 3200 cu. ft. per minute to 90-lb. pressure. Each is direct-connected to a 550-hp. Westinghouse synchronous motor, and in conjunction with each machine is an A-33 clearance regulator.

The appended figures show in a general way the results of the operations during the year 1920:

TABLE IV

Ruth Mine, Summary of All Mining Operations During the Year 1920			
	Porphyry mining	7th-level square-set mining	Total Ruth mine
Tons of ore hoisted.....	817,509	1,282	818,791
Number of days of operation.....	362	32	302
Average number of tons of ore hoisted per day	2,257	40.1	2,262
Average number of man-shifts per day, underground	183	13	184
Average number of tons of ore hoisted per man-shift, underground.....	12.30	3.09	12.27
*Average number of man-shifts per day.....	223	18.0	224.2
†Average number of tons of ore hoisted per man-shift	10.10	2.13	10.05
Average number of total man-shifts per day charged to Ruth mine.....	250	20.6	251.4
Average number of tons of ore hoisted per total man-shift.....	9.04	1.93	8.99
Total board-feet of timber used.....	3,105,451	30,433	3,135,884
Average number of tons of ore hoisted per 1000 bd.-ft. of timber.....	263	42.1	261
Total number of kilowatt-hours of elec- tric energy consumed	3,692,239	4,567	3,696,676
Average number of tons of ore hoisted per kilowatt-hour	0.221	0.281	0.221
Average number of kilowatt-hours per ton of ore hoisted.....	3.09	3.56	3.69
Total thousands of cubic feet of air consumed	824,439	256	824,695
Average number of tons of ore hoisted per thousands of cubic feet of air..	0.98	5.00	0.98
Average number of thousands of cubic feet of air per ton of ore hoisted..	1.03	0.20	0.98

*Exclusive of labor on deferred construction at the Ruth mine.

†Total man-shifts include labor of all descriptions charged to the Ruth mine.

It will be noted that in Table IV, 1282 tons of ore is

recorded as having been mined by square-set methods on the 7th level. This is from a deposit of high-grade ore first opened in the summer of 1920, at a point where the main cross-cut from the Star Pointer shaft first cut the ore-zone. Much of the ore assayed from 7 to 10% copper; it is a product of 'secondary' enrichment. It is possible that similar lenticular masses will be found at other points on the periphery of the central core formed by the main orebody, but the deposit is recognized to be only a comparatively small isolated bunch of ore in connection with which no great geologic or economic significance can be attached.

Table V is a recapitulation of the operating cost from the time production commenced in 1915 up to the present time. As appears from the items listed, the deferred cost of development, including the driving of haulage-drifts, is not part of mining expense. The figures do represent, however, every direct and indirect cost incurred from the time the branch raises are started until the ore is delivered to the storage-bins at the surface. Under the head 'Miscellaneous' are included the items of depreciation, depletion, and taxes of every kind. The incidence of Federal taxes is apparent in the large increase in this last item for 1917 and 1918 and in the decline during the following years when profits decreased. The fact that the direct operating cost for 1919 and 1920, on a greatly decreased tonnage, was no greater than in 1918 is accounted for by the improvement in the individual efficiency of the miners and also as a result of economies that have been effected by further systematization of operations.

It is interesting to revert to the early estimates of J. Parke Channing, Henry Krumb, and other engineers who agreed that \$1.50 per ton was a fair estimate of the probable cost for mining the Ruth ore. More significant still is the comparison of the cost at Ruth with that reported at two other mines where the ore deposits are somewhat similar. The mining cost at Ruth for 1919 was \$1.35 per ton including deferred charges for development and equipment. For the same year the cost of underground mining at the Ray Consolidated mine exclusive of sundry special charges for extracting high-grade ore by square-set methods is given as \$1.60; at the neighboring mine of the Miami Copper Company the cost for 1919 according to the annual report was \$1.540. Differences in the orebodies, in the working conditions, and in the methods of accounting, of course, vitiate the value of any direct comparison, but the records speak well for the work being done by the Nevada Consolidated company.

TABLE V

Ruth Mine, Per-Ton Cost of Producing Ore During the Period 1915 to 1920

	1915	1916	1917	1918	1919	1920
Tons produced	86,029	591,545	991,830	1,316,144	718,142	816,005
Branch raises and sub-levels.....	\$.....	\$0.0193	\$0.0972	\$0.2800	\$0.2344	\$0.2412
Under-cutting and caving	0.6443	0.3931	0.1982	0.1829	0.1300	0.1794
Tramming expense	0.1386	0.1473	0.0972	0.0867	0.0915	0.0794
Hoisting expense	0.0877	0.0579	0.0423	0.0364	0.0665	0.0615
General underground upkeep	0.3263	0.2902	0.2334	0.2249	0.2846	0.2436
General mine expense	0.0715	0.0466	0.0384	0.0444	0.0628	0.0708
Miscellaneous	0.1038	0.2477	0.3184	0.4102	0.1798	0.1391
Total	\$1.3722	\$1.2021	\$1.0251	\$1.2855	\$1.0490	\$1.0150

The Arizona Silver Mines Mill

By F. Borzynski

The mines and the mill of the Arizona Silver Mines Co. are situated on the eastern slopes of the East Humboldt range, Pershing county, Nevada. The town of Unionville is only two miles away, but the nearest shipping point, Mill City, is nearly 30 miles distant. A good wagon-road connects Mill City with Unionville and the mines.

In the early days, the Arizona mine produced rich silver ore. Later, when the grade diminished, the mine was abandoned and remained idle until 1912. During

ners and K & K flotation machines, and to treat the tailing by cyanide. The retention of flotation and vanner equipment was considered necessary on account of the large amount of stibnite and mineral oil in the ore. The new mill started operation on October 5, 1921; but flotation was discontinued after a few days run and the vanners were discarded two weeks later. Flotation was found to be superfluous, but the vanners helped to increase the extraction, producing concentrates containing between 350 and 550 oz. of silver per ton. Vanner con-

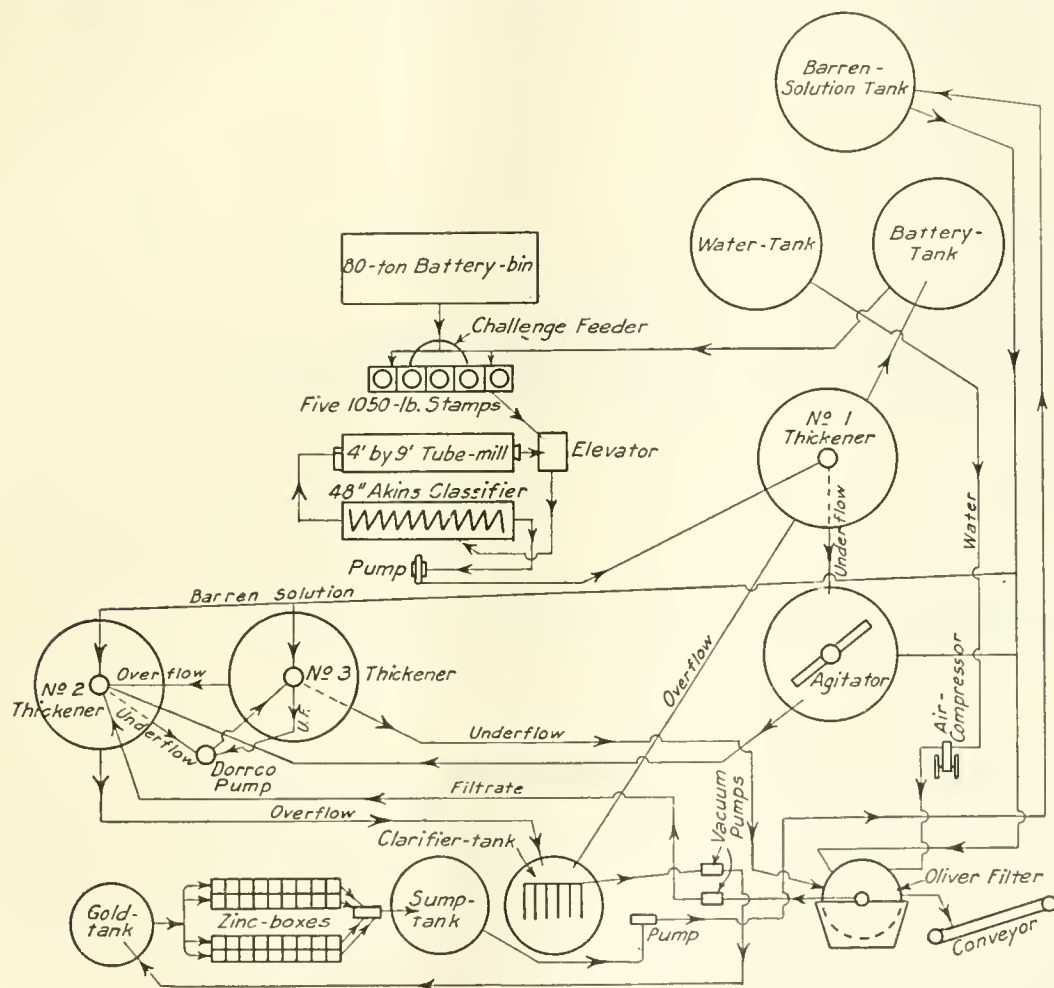


FIG. 1. FLOW-SHEET OF MILL

that year, a cyanide plant, equipped with a Chilean mill and Trent agitators, was built; and an attempt was made to treat the lower-grade ore still available. The venture proved a failure, chiefly because of the physical characteristics of the ore. A few years ago the mines were acquired by the Sunset Mining & Development Co., and a flotation plant was erected. This venture was a success, but the marketing of the large amount of comparatively low-grade concentrate was expensive; so the company decided to concentrate the ore roughly by means of van-

centration was suspended chiefly because the classifier overflow was too thin for efficient concentration; it may be resumed when means for thickening the classifier overflow are provided.

The ore consists of a mixture of quartz and lime carbonate, with small amounts of pyrite, stibnite, and, occasionally, scheelite. The lime carbonate varies from limestone to calcite in various proportions. The limestone is very calcareous, containing a considerable amount of oil. The valuable minerals are argentite and small

amounts of bromide and chloride of silver. A large amount of the quartz present in the ore is in the form of small crystals and fragments that are cemented by the lime and intermixed with calcite; consequently, the ore shatters easily. More than 60% of the Arizona mine ore, as it comes from underground, will pass a four-mesh screen. The remaining 40% is reduced in an old type of jaw-crusher by the mine crew during part of the day shift, so that all the ore delivered to the bin is sufficiently fine for stamping.

The capacity of the battery bin is 80 tons. From there the ore is fed to five 1050-lb. stamps by a Challenge feeder. The battery discharge is elevated with a small bucket-elevator to a 48-in. Akins classifier, in closed circuit with a 4 by 9-ft. tube-mill. The classifier overflow is delivered by a 2-in. centrifugal slime-pump to a Dorr thickener, 20 ft. in diameter and 11½ ft. high. The underflow, containing from 50 to 60% of solids, flows by

circulate the pulp of thickener No. 3 by continually taking it from the bottom and discharging it into the receiving well. This arrangement makes possible the accumulation and storage of pulp in the thickener when the filter is idle. Thickener No. 3 is similar to thickener No. 2. The pulp is again washed by the addition of three parts of barren solution to one part of solids. The overflow goes to thickener No. 2 and the underflow to an Oliver filter.

The filter is 12 by 8 ft. and is operated for part of the time only. The filter-cake is washed with sprays of barren solution and water. The wash-water is used as cooling water for the compressor, where it becomes warm. The washed cake is carried outside the mill by a 16-in. belt-conveyor. Vacuum is maintained with a 3-in. rotary pump. The clarifier tank is 16 by 5 ft. The clarifying medium consists of six home-made leaves, which are simple in design, easy to build, cheap, and satisfactory. The

leaves are connected to a 3-in. Roots rotary vacuum pump; the clarified solution is delivered to a 12 by 10-ft. tank. From this tank the rich solution flows by gravity to four 9-compartment zinc-boxes. The compartments are 20 by 22 by 24 in. and are made of sheet-iron. Nearly a ton of zinc shavings is required to fill the boxes, but at the present time only seven compartments of each box, two-thirds full, are needed. The solution from the zinc-boxes discharges into a rectangular box, 12 by 12 in. by 4 ft., and then through a vertical

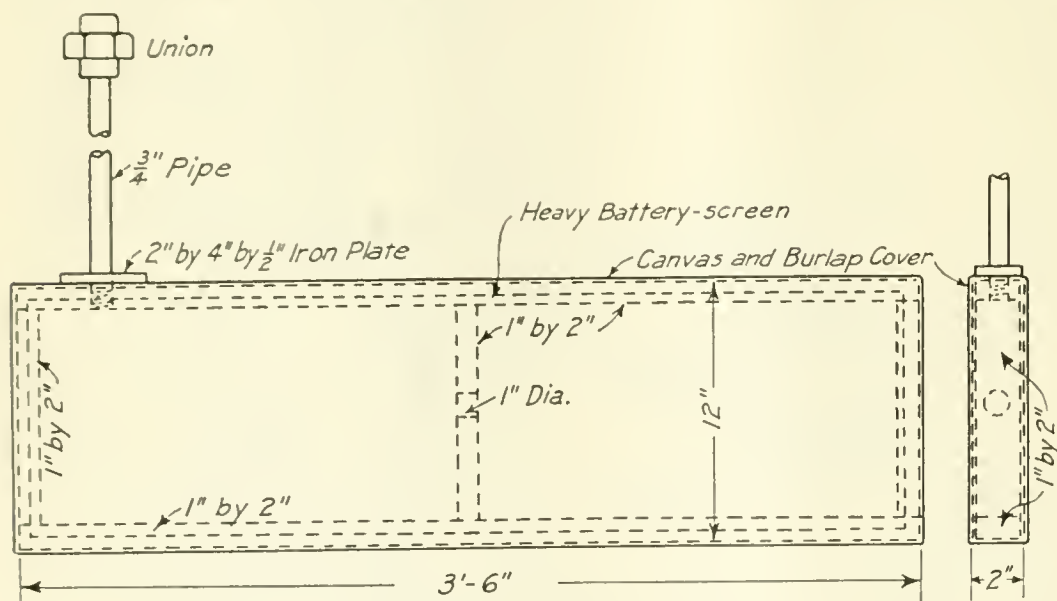


FIG. 2. VACUUM-LEAF IN CLARIFIER

gravity to a Dorr agitator, which is 18 ft. in diameter and 15 ft. high. Part of the overflow is sent to the clarifier and part to the battery storage-tank. The pulp in the agitator is diluted, with barren solution, to a consistence of 40% solids, the strength of the solution being maintained at 4 lb. per ton by the addition of fresh cyanide. The solid cyanide is placed in a basket and dissolved by the stream of solution used to reduce the specific gravity of the pulp. Every two hours, a part of the pulp from the agitator is transferred by gravity to No. 2 thickener, which is 18 ft. in diameter and 8 ft. high. The pulp from this is mixed with the overflow from No. 3 thickener and the Oliver filtrate. When the filter is idle, an equal amount of barren solution is substituted. The dilution in this thickener is four to one. The overflow is the richest solution in the mill and is sent to the clarifier.

The underflow from thickener No. 2 is pumped into thickener No. 3 with a 2-in. Dorco diaphragm pump; the piping is arranged so that it can either deliver the underflow from thickener No. 2 to thickener No. 3, or else can

weir into a 16 by 5-ft. sump-tank. A triplex-plunger pump delivers the solution from the tank to a 15 by 8-ft. barren-solution tank at the head of the mill.

The amount of ore treated per day is limited by the capacity of the tube-mill, which is 20 tons at the present time. The physical state of the ore is such that 50% slimes easily, whereas the other half is difficult to reduce beyond 60 mesh. The management has under consideration the separation of the slimes from the sands, and the treatment of the latter by leaching, in a separate plant. In case the leaching plant is erected, a ball- or rod-mill will be added to the crushing department. The present slime plant is large enough to handle at least 40 tons of slime per day. The ore settles rapidly, 3 sq. ft. of settling area per ton of ore being sufficient. The consumption of cyanide is 2.7 lb.; lime, 1.5 lb.; and lead acetate, 0.3 lb., per ton of ore. By careful proportioning of the amounts of cyanide, lime, and lead acetate, the oil in the ore is rendered comparatively harmless. Flotation before cyanidation is unnecessary.

The Ways of the London Silver Market

By Robert P. Skinner, U. S. Consul General in London

*The London silver market is the greatest in the world. Its importance is so firmly established as to have given rise to the impression that the brokers by whom the daily changes are recorded operate under a patent from the Crown, all others being prohibited from participating in these transactions.

The suggestion is made that there is no actual open market either in London or in New York for trading in silver; that is to say, "there is no competitive bidding among brokers and no market place open to all interested, and, further, there are no opening and closing quotations". The main suggestion that the London silver market is in the hands of four particular concerns is undoubtedly true, but it is not a fact that this practical monopoly has been legalized by the Government in any manner, and there is no reason in law why anyone who wishes to do so should not set up as a broker in silver in London if he can find clients willing to employ his services.

For several generations four firms have formed the London silver market, namely, Mocatta & Goldsmid, Sharpe & Wilkins, Pixley & Abell, and Samuel Montagu & Co.

Mocatta & Goldsmid started business in 1695 as bullion brokers on behalf of the Bank of England, and had their office in the present Bank of England. They were practically the bullion department of the bank, and bullion in those days represented coin, bars being seldom seen. After about 125 years of this monopoly a large constituent of the firm started one of the firm's clerks in business outside the Bank of England; this undertaking developed into the firm of Sharpe & Wilkins. At a later date Pixley & Abell appeared in the same business, and more recently, somewhere about 30 or 35 years ago, Samuel Montagu & Co. began to include bullion transactions along with the details of their banking business, which they had carried on for a long time.

It is said on behalf of these four firms that their position is due to their own high standing and the confidence arising from methods and practices adopted to protect the interests of buyer and seller alike.

What is called 'fixing' the price of silver is a London operation which controls the price of the metal in several important financial centres throughout the world. The official quotations are cabled abroad by each of the four firms named to their foreign clients. The great bulk of the daily business transacted is based upon the price, which is determined by 1:45 p.m. every day in the week (on Saturday the hour is 11:45 a.m.), when the representatives of the respective firms meet at the office of one of their number.

Each of the four brokers is permitted to disclose the excess of his own position as a buyer or seller at a given price while preserving the anonymity of his client. It will thus be seen that while one of the firms may do an enormous business on any one day, the difference between purchases and sales may be extremely small; and carrying this idea through the four firms it will be seen that while the total volume of trade may be enormous the amount changing hands between the four concerns may be trifling.

In an interesting work entitled 'Silver, its history and romance', by Benjamin White, the following paragraphs on the price-fixing method appear:

"The method of fixing the price is very simple. The first step is usually to ascertain if there is occasion to alter the price of the day before. If supplies prove insufficient to satisfy buying orders higher prices are suggested until the offerings balance the demand. Should offerings at the preceding day's price exceed the amount of buying orders, the price is lowered until equipoise is obtained. Usually a number of orders at different limits have been left in hand by clients, to buy or sell; with the assistance of these orders the price can be adjusted to a nicety. By this method of fixing the quotation the scale is evenly held between the buyer and the seller for whom the brokers act.

"As a rule, two prices are agreed upon at 'fixing', one for a cash delivery, which implies delivery within seven days—at the option of the seller—and the other for delivery in two months time; that is to say, exactly after two calendar months interval. A period of two months is selected because it is found the most convenient interval at which smelters can undertake to deliver the silver which they have purchased in the form of ore."

From a high authority in the London financial world the writer has obtained some further interesting details about the technique of the business:

"The statement you quote that the brokers meet daily to 'fix between themselves the price for which they will buy and sell for that day' is not quite accurate. The fact is that the brokers do not buy and sell; the brokers 'broke' on commission; their clients buy and sell. Their clients are chiefly exchange banks interested in many parts of the world, but so far as silver is concerned chiefly in India and China.

"China and India have each of them a rate of exchange on England. These rates of exchange vary almost daily, and each rate of exchange has an equivalent in silver bullion. For example, if the rate of exchange in Shanghai is 9s. per Chinese tael, silver bullion is worth a very high figure per ounce; if exchange is 4s. 6d., the price that they will pay for silver bullion is only half the

*'Commerce Reports', April 5, 1921.

former price. Both these rates of exchange have been current within the last 12 months, hence the wide fluctuation in the price of silver without the slightest manipulation on the part of the brokers. The banks know what rates for silver will pay them and what will not pay them, and they give their orders accordingly; that is, usually with limits—say: 'Buy [or sell] on our account 100,000 ounces today at 42d., or perhaps a fraction higher, but not above 42½d.'

"The fact is that the China and India rates of exchange on London dominate the silver market, hence the fact that the London market dominates the American price of silver. Now, if the London price is 50d. and the rate of exchange on New York is \$4.86, the market price is a very different figure if the rate of exchange moves to \$3.50 per English pound. This provides you with two variables—first, the Chinese or Indian rate on England and then the London rate on New York; and all the mysteries of variations in the price of silver come down to these two factors, so that the mysteries are simplicity itself. They are simply buying and selling by responsible banks through responsible brokers. Silver is a commodity and travels up and down in response to supply and demand and cannot be made to follow the wishes of producers any more than wheat or cotton can be kept within certain bounds."

Answering a question on the subject of competition from other silver markets this same authority said:

"Outside competition would hardly stand a chance within the next 50 years, if that. First of all, a broker requires a clientele on both sides of the ledger; for instance, at present the large supplies of Continental silver resulting from the melting down of Continental currencies come to the brokers through their old Continental customers, collected together into their books through the experience of years and years. During the last nine months these supplies of Continental silver have been very much larger than supplies of American silver—in fact, the market has been, to a large extent, independent of American supplies—and we believe that there were times when America sold nothing here, but, instead, sold it for delivery in San Francisco to exchange banks (representatives of the exchange banks here). However, they have been able to sell there only at the equivalent of the rate arranged in London on the day of their sales in San Francisco or New York, or close thereto, so that London has still dominated the American market.

"At present it looks as though the Continent of Europe can go on selling indefinitely, largely owing to the fact that Continental rates of exchange are so high here as to give the sellers a wonderful return for their currencies. For instance, at 260 marks per pound on Berlin, Berlin is reaping in paper, 13 times its normal return on silver. In addition, China and India have absorbed such abnormally large quantities of silver while the prices of produce were high that it looks hardly possible for either of them to continue absorbing at anything like the same pace; in fact, there is quite a possibility, if not a probability, that with trade in its present languishing condi-

tion the world over, large disgorgements of silver from those quarters might take place.

"You will appreciate that bullion brokers have to be aware of, and in daily touch with, all these factors, and also that it is not a business which can be taken hold of at five minutes notice and proceeded with in the absence of long and inherited experience."

Undoubtedly the four firms in charge of the London market exercise an enormous power, which extends to every part of the world and particularly to the United States, India, and China; but inquiry fails to disclose a single definite complaint that they artificially manipulate the market, although numerous observers recognize that they are potentially able to do so.

As already stated, there are no governmental measures of special character which apply to this business. However, a bill is now pending in Parliament which provides that it shall be unlawful for any person except under Treasury license to melt down, break up, or use otherwise than as currency any gold or silver coin that is for the time being current in the United Kingdom or any foreign country, and that likewise includes silver coin and gold or silver bullion among the articles the customs authorities may prohibit from exportation.

An agreement was made in 1919 between the Dominion Department of the Interior and the Hydro-Electric Commission of Ontario, whereby the Dominion Water Power Branch became responsible for all basic investigation respecting water resources, and the Province undertook detailed investigation and construction, states a consular report. A special Federal bureau was formed to deal with this work. During the past year stream measurements and investigations have been largely extended, and an inventory and analysis of developed and undeveloped power and storage resources is now being prepared. Included in this work are the studies of the St. Lawrence river and the regulation of the Lake of the Woods for storage purposes. The progress in actual construction includes the installation of two new units of 20,000 hp. each in the plant owned by the Ontario Power Co. at Niagara and the completion of a 3500-hp. plant at High Falls, near Perth. Development at Queenston on the Niagara was continued, and it is expected that power will be available from this plant in September; the initial installation is of five 60,000-hp. units, with an ultimate capacity of 540,000 hp. Development on the Nipigon, to supply the Port Arthur and Fort William districts, with an initial installation of 25,000 hp., and an ultimate capacity of 75,000 hp. was continued, and power is now being supplied from the first unit. Construction was begun on a 10,000-hp. plant at Ranneys Falls, near Campbellford, to supply the central Ontario system. The total capacity of plants now owned by the Hydro-Electric Power Commission is given as over 1,000,000 hp. Private developments included the completion of a dam for a 15,000-hp. plant on Spanish river at Algoma for the International Nickel Co. In all there was a total of about 500,000 hp. under construction in Ontario in 1920.

REVIEW OF MINING



UTAH MINING COMPANIES RESIST ATTEMPT ON PART OF A. S. & R. CO. TO ABROGATE SMELTER CONTRACTS

The Silver King Coalition and the Daly-West mining companies, whose mines are at Park City, have decided to resist all attempts of the American Smelting & Refining Co. to abrogate their unexpired contracts relating to charges for the treatment of ores. Notification was recently received from the American Smelting & Refining Co. stating that after May 15 no ores would be accepted by it under the rates provided for under the old contracts, notwithstanding the fact that these agreements had several years to run.

With this notification a new schedule of rates was submitted by the smelting company for approval. The reason for refusing to accept the ores under the old contracts was that the charges stipulated therein were unprofitable under present operating costs.

Although but two companies at present are directly affected by the proposed abrogation of unexpired contracts, Utah mine operators are watching closely developments bound to arise out of the controversy. Feeling in mining circles is running high, for it is felt that if the American Smelting & Refining Co. can abrogate its contracts when they are deemed unsatisfactory and live up to them only when they are favorable, it will be futile in the future to make an agreement providing for a stipulated smelting-charge over a term of years.

Many mining operators feel that if the smelting company is able to impose arbitrarily smelting rates favorable alone to its own interests, a blow will have been struck at the intermountain metal industry from which it will be slow to recover. Out of this conflict, many mining men believe that there will grow a co-operative movement whereby producers will be enabled to market their own ores. As a matter of fact, the practicability of mining companies owning and operating a co-operative smelter is being strongly discussed.

Regarding the controversy, W. Mont Ferry, managing director of the Silver King Coalition Mines Co., made the following statement: "The contract held by the King Coalition Mines Co. was entered into January 1, 1914, for a period of ten years. This contract provided for a fixed rate for the first five years and for a lessened charge during the second five years, beginning January 1, 1919.

"Under the contract, the American Smelting & Refining Co. agrees to take all crude ore and concentrates up to a limit, as yet never approached, and to make certain stipulated charges upon receipt f.o.b. Park City. Now the smelting company proposes to revoke this contract because under its terms treatment of Silver King Coalition Mines ore is unprofitable.

"Furthermore, we have been informed by the smelting company that it is only the agent of the miner, his middleman, and that no loss of income resulting from an increase in the cost of operation will be sustained by it. In other words, the smelting company announces that, notwithstanding any contract it may make, the miner must be prepared to meet any increase in reduction costs by an advanced smelting charge. We fully intend to hold the smelting company strictly to the letter of the contract.

"Even if the contract is unfavorable to the American Smelting & Refining Co., this is hardly a justifiable reason for attempting to disregard it and arbitrarily impose rates which are on the average 75% higher than those in force at present.

"For twenty-eight years the Silver King Coalition Mines Co. has shipped its ores to the American Smelting & Refining Co. Though the terms of past contracts under which ore was sold to the smelting company have not been always favorable to the best interests of the mine, they were lived up to."

George W. Lambourne, president and general manager of the Daly-West Mining Co., says that his company would take the same stand as that of the Silver King Coalition company. He said that he had "no intention of complying with the unjust demands of the smelting company", and that his company would insist that the terms of the contract, which has about four years to run yet, should be fulfilled.

J. M. Bidwell, general manager for the A. S. & R. Co. in Utah, made a statement from which the following is extracted: "Each contract contains a provision that when and if conditions arise in the smelting business beyond the control of the company which render the smelting of their ores unprofitable at the contract rates, or make it a disability or serious hardship to receive and smelt them, then the contracts may be suspended.

"The contracts also provide that in case market or mining conditions make it a serious hardship for the mining companies to ship ores, they shall not be obligated to ship them. In other words, if the cost of mining became excessively high, or the metal prices excessively low, and the mining companies cannot ship at a profit under the contract, they are not obligated to ship their ores.

"A contract to be binding upon both parties must be mutual, and if the mine owner is not required to ship, if in his judgment he cannot do so to advantage, the same condition should apply to the smelting company; and if conditions should arise making the handling of the ore by the smelting company a serious hardship they should have the same right of either asking the mining company to discontinue shipments or to ask them to pay more money to smelt their ores.

"The smelting company has notified these two mining companies that their ores will be received if they will pay the actual cost of smelting them figured without one cent of profit to the smelter; and they have been advised that each month the smelting company will figure its cost and when these costs become lower than at present the mining companies will be given the benefit of such reductions.

"We feel that these reductions will be material and will come about in the near future. The smelting company is doing everything possible to bring about lower costs, all of which shall inure to the benefit of the mines."

Regarding the so-called disability clause, Mr. Ferry contradicts the statement of the A. S. & R. officials. He quotes the clause verbatim as follows: "In case of acts of nature, strikes of any kind, affecting the operations of the contracting parties, fires, floods, shortage of cars, financial crises, war or insurrections, or any cause whatsoever, which, being beyond the control of the contracting parties or either of

them, shall make it a disability on the part of the mining company to ship the product herein contracted, or for the smelting company to receive, purchase and treat such product, the parties hereto shall be relieved of all responsibility or claim for damage for failure to ship or receive the product; but shipments and receipts shall be resumed as soon as the disabling cause is removed, and the period of such interruption or interruptions shall be added to the time provided for in this contract."

THE STRIKE AT TONOPAH

The strike at Tonopah, at the time of our going to press, had become more serious, with both sides apparently resolved on a finish fight. The Tonopah-Belmont Development Co., the largest operator in the district, has discharged all salaried employees, including shift-bosses, and several other companies were reported to be planning like action. An attempt last week to break the strike by importing forty-five strikebreakers from California failed when the men were persuaded to leave the camp by the strikers. The lower workings of the Belmont, Tonopah-Extension, and other mines are filling with water, and, according to officials, several months will be required to place these workings in shape for mining even should the strike speedily terminate. Large numbers of men are commencing to leave for other points and the business outlook is gloomy.

Operations remain normal at Klondyke, but it is unlikely that the lessees can work much longer without an outlet for their ore, as previous to the strike all Klondyke ore was treated by mills at Tonopah and Millers. The companies that continue to pay the old scale make more difficult the position of the operators who have announced a wage-cut. Practically all companies with the exception of the Tonopah Divide are working at Divide under the old scale. The move to cut wages is said to have been made by the Eastern interests in the big companies and these interests would have more sympathy in their attempt if the move had not been so sudden, according to the talk heard among mining men throughout the State.

HOMESTAKE PAYS DIVIDEND

The Homestake Mining Co., whose mines are at Lead, South Dakota, has declared a dividend of 25c. per share. This is the first dividend that the company has paid since September 25, 1919. The total dividends amount to slightly more than \$42,000,000.

ARIZONA

Bisbee.—The Calumet & Arizona and Copper Queen mining companies are preparing to do development work in the White Tailed Deer district. The Calumet & Arizona is installing a hoist at the Cole No. 3 shaft and will start drifting from the lower levels. The Copper Queen company will work from the White Tailed Deer shaft.

The Calumet & Arizona company has stopped sinking operations at the Campbell shaft on account of the flow of water which has increased to such an extent that it can no longer be bailed. The shaft is now below the 1700-ft. level. It has been concreted 698 ft. from the collar, and work of concreting the rest of the way has been commenced.

The drift from the 1800-ft. level of the Junction that will drain the Campbell shaft is now about 200 ft. from the shaft. As the Junction is the pumping shaft for all the C. & A. mines it will be necessary to maintain the bottom of the Junction at a lower level than the other shafts. If the Campbell shaft is to be sunk much farther, it will be necessary first to sink the Junction.

Pulling of the pumps at the Denn mine has had no appreciable effect on pumping at the Junction. The Denn mine

has filled up to about 33 ft. from the 1600-ft. level, on which is the connection with the Junction.

Jerome.—The United Verde Extension produced 3,092,746 lb. of copper in April, compared with 2,951,390 lb. in March, and 3,349,942 in February.

Kingman.—Work is progressing on the Nancy Lee property, situated in Secret Pass about four miles from the Katherine mine. The Nancy Lee carries a vein of lime-quartz the outcrop of which assays from \$2 to \$10 per ton. A cross-cut adit has been driven a length of 100 ft. for the purpose of tapping the vein at depth and will reach its objective about 50 ft. in advance of the present heading.

—At the Sunbeam property, Ed. Chaffee, superintendent, is preparing to install a 40-hp. hoist, a 350-cu. ft. air-compressor, and a 75-hp. gas-engine. Mr. Chaffee negotiated the sale of the Sunbeam to W. J. Loring and has been supplied with the funds necessary to develop the property. The work will include the sinking of a double-compartment shaft to a depth of 500 ft.—On the adjoining Adams group, machinery is being installed. N. I. D'Arcy and E. H. Newland are backing the venture.

Tombstone.—An arrangement has been perfected by John H. Davis, superintendent of the Bunker Hill Mines Co., whereby 1000 tons of lead-silver ore from this district will be shipped to the smelter at El Paso. The ore is desired partly for its fluxing properties, and a low treatment-rate has accordingly been made. The Lucky Cuss and Oregon mines will probably supply most of the ore.

Winkelman.—The report of the discovery of \$20 gold ore on several claims in Gold canyon north of the Gila river between Kelvin and Winkelman has caused a small 'rush' into the district. The original discovery was made on the Victor No. 1 claim belonging to Riggins and Schuyler. About 30 claims have been located to date.

Winslow.—It is reported that the Colorado Fuel & Iron Co. has taken a lease on a large acreage of iron-bearing ground on the Apache Indian Reservation 60 miles south of Winslow. It is said that there is a large tonnage of known ore that will average 55% iron. Drilling operations are to be commenced to further prove the area.

CALIFORNIA

Forest City.—The Kate Hardy Mining Co. is erecting a new 10-stamp mill. Following the practice at the Empire and North Star mines, at Grass Valley, 1650-lb. stamps are being used in preference to lighter ones. High-grade equipment is being used throughout.

Grass Valley.—The Alta Combination Mines Co., under the direction of H. L. Ostrander, has extended the adit at the Baltic property to a length of 1000 ft. It is expected to reach the Alta Hill gravel channel at a point about 750 ft. farther on. A new reservoir will supply water for power purposes under a head of 212 ft. The Alta California Co. is said to have entered the gravel channel.

Redding.—The Mountain Copper Co.'s output at the Hor-net mine has been cut down to 4000 tons per month, that being all that the General Chemical Co. at Bay Point requires. The Chemical company took 15,000 tons in February, 10,000 tons in March, 8000 tons in April, and now only 4000 tons is wanted in May. The decrease is due to the falling-off in the demand for sulphuric acid and fertilizers. The company has been obliged to reduce its force from 150 to 100 men.

Shoshone.—The Associated Oil Co., the Pacific Coast Borax Co., and W. S. Bayliss are each developing, or prospecting for, deposits of fuller's earth.—Preparations are being made to treat with cyanide the old dumps at the Confidence mine.—The Silver Valley Development Co. has sunk a 250-ft. shaft on its claim 25 miles north of here. In-

dications are favorable for the development of silver-lead ore.—J. J. Jarvis, of New York, is developing the Silver Rule and Blackwater properties in the hope of finding silver-lead ore.

Tecopa.—Lessees are working on the 700-ft. level in the Gunsite claim of the Tecopa Consolidated and the company is doing development work. The Tecopa is a lead-silver mine that is opened or closed according to the price of lead, freight-rates, and smelter-charges.

Tuolumne County.—G. L. Sledge, W. W. Godsmark, O. H. Crane, and other men from Los Angeles have taken over the W. N. Sledge gravel claims four miles east of here. These claims formerly belonged to the Tuolumne Deep Channel Mining Co. and were in litigation for many years. The matter was settled in court a short time ago, the present owners gaining control. The new owners will begin work immediately.

COLORADO

Aspen.—The rich shoot in the Hope tunnel has been proved by drifting to be 55 ft. long; a raise from the tunnel-level has opened a strong body of silver-lead ore in a dark lime, with the richness steadily increasing, according to the recent report of the directors to the stockholders. Roads are clearing and shipments will start this month.

The Anaconda group on Porphyry mountain has been taken over by Salt Lake operators and the Argenta group in the same section by Chicago and Eastern interests. The Aspen Silver-Lead Mines Co. continues development of its Porphyry mountain properties and will be shipping shortly.

Black Hawk.—The Midwest Mining Co. has increased its operating force. The new mill will shortly be completed and large reserves of ore are available. The old plant continues operating and is turning out a good grade of concentrate.—The Silver Mountain Mining Co. has entered a body of smelting-grade ore between the 260 and 200-ft. levels and is prospecting undeveloped territory by cross-cutting.

Cripple Creek.—Extension of the Roosevelt drainage tunnel from its present terminal on the Portland estate to the Vindicator Con. Gold Mining Co.'s No. 2 shaft, a distance of approximately 3000 ft., is under consideration by the Vindicator directorate. The estimated cost is between \$100,000 and \$150,000. Rich ore has recently been found in the Vindicator mine at a depth of 2000 ft., but the cost of raising water is heavy and eats up profits.

The Jo Dandy mine on Raven hill and the Mary Ann adjoining, owned by the mining companies of the same names, have been taken under lease by T. B. Burbridge, of Denver, a director of the Cresson Consolidated Gold Mining Co., whose property the Mary Ann adjoins. A bond has been secured on the Mary Ann. The lease is significant, although Burbridge declares the Cresson company is not interested.

The Jo Dandy was, until closed down about three years ago, a producer of high-grade ore, but the Mary Ann has been inactive and undeveloped since patent issued, except for prospecting by lessees.

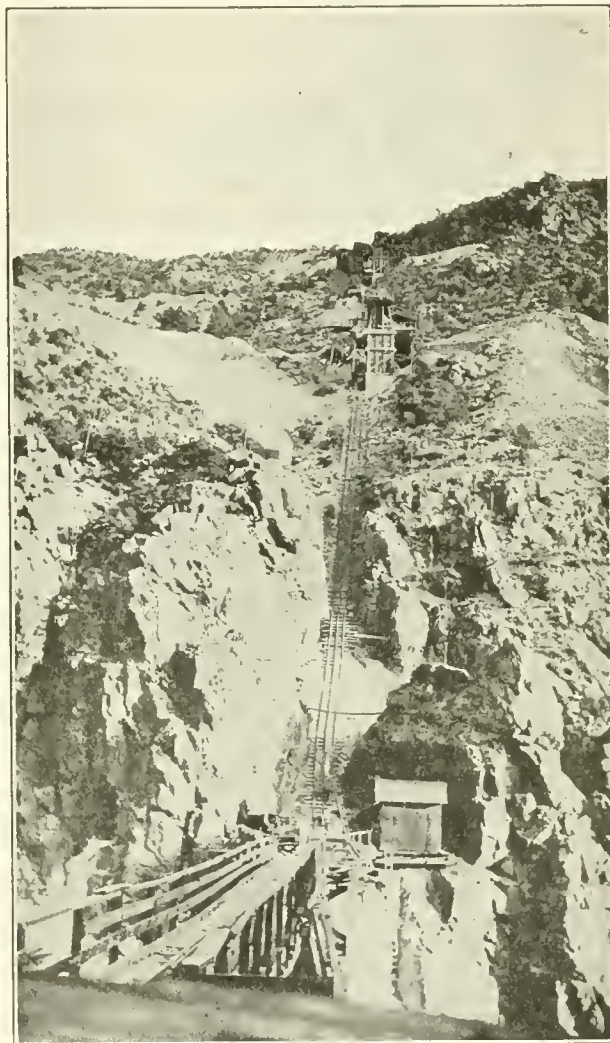
Kokomo.—The Mutual Co-operative Mining Co., of Denver, is receiving royalties from shipments from the Silver Queen mine. Five cars were recently settled for by the A. V. smelter at Leadville, and two other cars await settlement. The force has been increased by the lessee, and royalties from shipments, it is estimated, will average \$200 per week.

IDAHO

Coeur d'Alene.—The Bunker Hill & Sullivan company has been commended by Stewart Campbell, State Mine Inspector, for the exceptionally fine condition of its mine and the methods used to prevent accidents. Favorable comment

was made upon the large concrete change-house built near the entrance to the Kellogg tunnel for the convenience of the miners. The change-house is equipped with hot and cold showers, drinking-fountains, lockers, and other conveniences. Precautions against fire in the mine, shops, and buildings by the application of a coat of gunite is also mentioned.

According to official statements of mining companies filed with the Shoshone county assessor, the total production for the Coeur d'Alene region in 1920 was 130,822,570 tons of ore, valued at \$24,804,860, and net profits were \$6,318,855. The largest producer was the Bunker Hill & Sullivan com-



King Incline, Arizona Copper Co., at Metcalf

pany, with 409,986 gross tons of ore. The Morning mine of the Federal Mining & Smelting Co., at Mullan, was second with 314,027 tons, and the Hecla mine at Burke was third with 229,893 tons. The net profits of the different companies were as follows: Bunker Hill & Sullivan, \$2,593,089; Hercules, \$1,147,706; Hecla, \$1,092,602; Federal (Morning mine), \$568,072. The Bunker Hill profits, according to officials, were made during the first six months of 1920, when war prices for metals still prevailed. The company has about 'broken even' since then.

The North Star Mining & Development Co. has extended its tunnel 174 ft. and re-opened and re-timbered 50 ft. of caved tunnel, put in a trestle that cost \$400, added to the equipment a blower for the blacksmith shop, 300 ft. of 10-in air-pipe, a fan, and other improvements.

The recent strike of high-grade gray-copper ore on the

Sterling Silver property is encouraging, according to Harry Morrell, manager. The vein was cut at a depth of 300 ft. from the surface on the lower level of the workings while a cross cut was being driven to open a vein found on the surface. Three feet of gray-copper ore was opened. Five men are at work and cross-cutting will be continued 350 ft. to cut the vein. The mine is seven miles from Kellogg, and the ore can be hauled to the Bunker Hill & Sullivan smelter with small transportation cost.

Marsh stockholders have received word that arrangements have been made to use the Gertie tunnel for development at depth. "It seems to have been the unanimous opinion of the stockholders at the annual meeting that the company's ground east of the Hecla and carrying the extension of the Russell vein should be promptly and aggressively developed," says the report.

The Marsh company plans to concentrate development in following the easterly extension of the Russell vein. The present drift will be continued for sufficient distance to prove the course and dip of the vein, when it is planned to open it at the elevation of the No. 2 Marsh tunnel, 1000 ft. below.

According to T. B. Cosgrove, the American Commander company is finding stringers of high-grade ore running into the foot-wall in the new tunnel that are expected to develop into a high-grade streak on the foot-wall and make into the milling ore on the hanging wall. A feature of the present situation is that tunnel No. 1, which has been driven 1500 ft., is beneath this point and a cross-cut of 70 ft. should tap the ore-shoot at a depth of 450 ft. A compressor is being put in No. 1 tunnel to supply air to the American Commander, the Independent Lead, and the West Hunter.

The Reed Level Mining Co. has completed mill improvements and the installation of the slime-dumping plant, flotation unit, and ore-drying process. Fourteen cars of lead-silver concentrate were shipped to the Bunker-Hill & Sullivan smelter with net returns of \$1000 per car, which paid the cost of operation at the present prices of these metals. Three stopes are being worked. Recently a shoot of milling ore 16 ft. wide, showing more than 18 in. of high-grade galena on the foot-wall, was opened.

Mackay.—Homer V. Jerkins, manager for the Empire Copper Co., states that the company has adopted a schedule of shipments of one car per day. Lessees on this property will thus be enabled to ship much of the ore which has accumulated since the threatened shut-down. The mine is in excellent physical condition and several cars per day could be shipped were it not for the excessively high freight-rates which make shipment of the lower-grade ore unprofitable.

At the Doughboy mine drifting has been commenced on the 450-ft. level, the depth at which the last ore was struck. Past shipments from the mine have shown an average of 54 oz. silver and 50% lead. The mine was equipped for development work last fall and new machinery has been installed this spring. An average of six cars per month will be shipped as long as the weather permits, these shipments to be made from the accumulation of ore resulting from development work.

MICHIGAN

Houghton.—One steamer has just taken out 3,100,000 lb. of copper, the cargo being valued, at the present price of the metal, at about \$400,000. Of this amount, 1,000,000 lb. was Quincy copper, this representing the largest shipment Quincy has made in many months. The bulk of its sales for a considerable period have been to a wire-mill in this district, which has taken as high as a million pounds in a month. Calumet & Hecla had in this cargo, 1,200,000 lb., bound for Germany, it being part of the German business already reported. The remainder, 900,000 lb., was Copper Range metal going to consumers in the East. The

shipment of this large cargo bears out the prediction that the opening of the season of navigation would witness a considerable movement of copper down the lakes and if business continues at the present rate the surplus will have been reduced to almost normal proportions by fall. The bill introduced in the Michigan legislature at its recent session by W. F. Miller, of Houghton, to permit mining companies to engage in manufacturing was tabled, but its provisions were enacted into law by adding them to the general corporation law as an amendment. While this gives the copper-mining companies of Michigan the legal right to engage in the manufacture of their copper into finished articles in this State, it is doubtful whether any manufacturing plants ever will be established here. If any of the companies go into the manufacturing business it is the belief of local officials that the plants will be established in industrial centres, perhaps in the East, on account of competitive and marketing conditions.

Copper Range has started work on the re-timbering of No. 3 shaft, Champion mine. The shaft began to cave two years ago and has not been in use since. The work is being done now because it is possible to get expert timbermen. It will require at least four months, as the shaft is in bad shape. The shaft is 2339 ft. deep and bottoms at the 21st level. Copper Range is still experiencing a big labor turnover. The number of men leaving the mines for work on farms or elsewhere is even greater than usual at this time of the year. It is difficult to account for this apparent restless feeling. No difficulty, however, is being met in filling the places of those who leave. On the present basis of operations the three Copper Range mines are producing at the rate of about 2,600,000 lb. of refined copper per month, or 31,200,000 lb. per year. This compares with 33,025,959 in 1919 and with 23,756,267 in 1920.

Champion is now hoisting at the rate of about 560,000 tons of 'rock' monthly, of which 555,000 is stamped; Baltic is hoisting about 218,000, of which 163,100 is stamped; and Trimountain is hoisting 124,000, of which 75,000 is stamped. The total rock tonnage per month is 902,000, while rock stamped totals 793,500.

The copper now being disclosed in the 6th level drifts at the Seneca property seem to indicate that ore persists with depth. The 6th level is showing up as well as any of the openings in the preceding levels. Good ore continues to come from stoping operations on the 4th level, north.

MISSOURI

Joplin.—There was an advance in price of lead during the week ended May 7, which brought the market up to \$60 for the major portion of the tonnage sold. There were reports of sales at \$61.50, but these were not verified. The demand was heavy but the sales were restricted, due partly to the fact that production is low and the surplus is strongly held. Zinc ores also showed some strength at \$26 per ton, at which price approximately double the tonnage was sold that was marketed the previous week. Sales have been growing increasingly difficult, due to the small production.

MONTANA

Butte.—Cross-cutting north from the Butte-Plutus company's shaft on the 400-ft. level for the Norwich vein continues. The wall upon which a deposit of ore has been found nearer the surface is expected to be reached shortly. —With a partial resumption of work at the Washoe reduction works it is announced that the Tuolumne Mining Co. will resume shipping silver ore to the Anaconda plant for treatment. The Tuolumne stopped ore shipments when the smelter closed down.—J. L. Bruce, manager of the Davis-Daly mines, described the new ventilating system at the Colorado mine at a recent meeting of the Montana Society of Engineers. He said that 9000 cu. ft. of air per

minute, traveling at a velocity of 600 ft. per minute, enters the mine through a large octagonal down-cast shaft, especially driven to provide ventilation.

Fergus County.—Fifty men are now employed by the British syndicate that is working the sapphire mines. Montana is the first State in the Union in the production of precious stones.

NEVADA

Alpine.—The suit brought by the Nevada Lincoln company to recover the silver mine of that name has been settled out of court and as a result work is to be started by a new company, which will be financed by G. S. Johnson, of Fort Worth, Texas. The Nevada Wilson was organized after Frank Wilson had bought the property, then owned by the Nevada Lincoln, at a sheriff's sale. Tasker L. Oddie, United States Senator from Nevada, at one time had an option to purchase the mine for \$135,000. The claims are developed to a limited extent by a 400-ft. tunnel cutting the vein at a depth of 150 feet.

Ely.—Prospecting of promising silverbearing lodes on McCoy creek is planned by J. O. McKernan, D. B. Bailey, and D. C. McDonald. In all, 27 claims have been located in recent years.

Fifteen feet of good ore has been exposed on a sub-level 27 ft. below the main tunnel of the Boston & Ely Consolidated mine. Stocks of first- and second-class ore are rapidly accumulating on the dump. S. H. Williams is resident manager.

Hornsilver.—Nothing has been heard yet of a decision being reached by the Tonopah Mining Co. following the examination of the Orleans mine by its engineers. It is said that the examination was the most thorough ever made by the Tonopah Mining with one exception and that the result was highly satisfactory.

Klondyke.—Seven lessees are working in ore on the Original Klondyke. Although no shipments are being made, the activity in the district is greater than ever before and ore is accumulating rapidly.

Lovelock.—The old Darby mill, at Vernon, has been started up, milling ore for the Seven Troughs Mining Co. on a former contract that was never finished. Brook Hartley is superintendent.

Pioche.—The new town of Silverhorn is now supplied with water through the recently completed pipe-line from the Nevada Silverhorn company's spring. A store has been opened and a stage-line has been established between Silverhorn and Pioche. J. Nelson Nevius has completed an investigation of the geology of the company's property.

Pioneer.—Fair assays have been obtained in the Pioneer Consolidated shaft for the first time since sinking was resumed. It is estimated that the objective, 800 ft., will be reached in about 60 days, according to W. J. Tobin, general manager. Track is being laid from the Starlight tunnel to the mill, and production of good ore will be made from this tunnel. The Mayflower is now letting leases. The Pioneer shaft is 660 ft. deep.

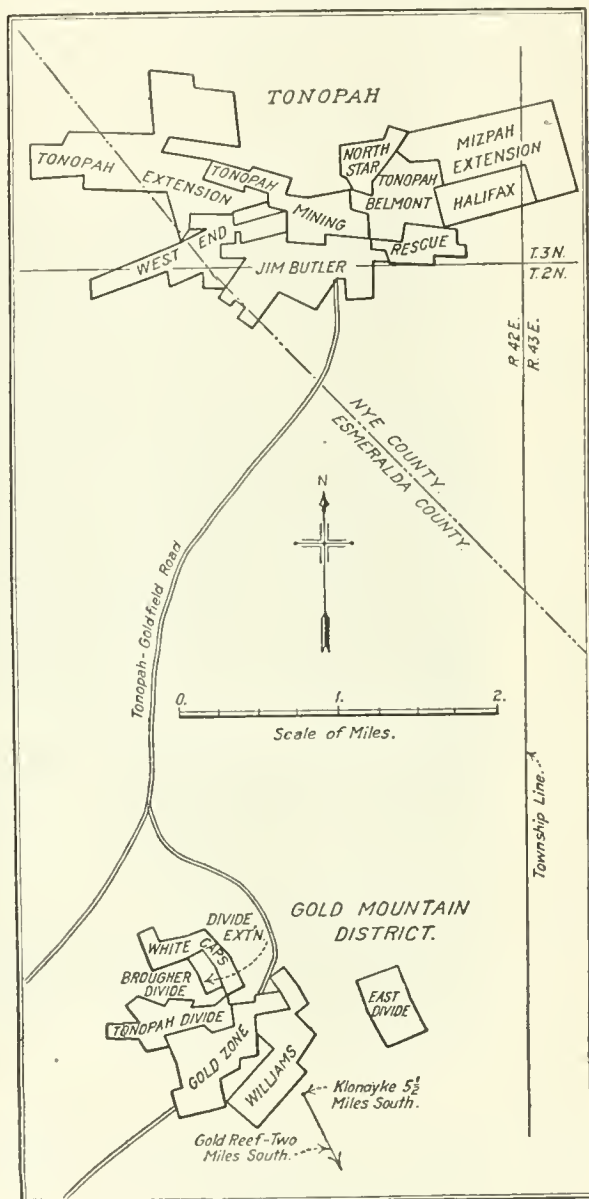
Rochester.—On May 10 the miners and millmen employed by the Rochester Silver Corporation voted unanimously to return to work after a two-weeks strike following a reduction in wages of 50c. per day.—The mill of the Nevada Packard company is again in operation. The mill was shut-down last August, the reason assigned being a shortage of water for the generation of electric power. Recent development in the mine is said to be favorable.

Silverton.—It is reported that the Tognoni group is to be taken over by the Silver Hills. There is a good showing of silver ore on the surface of this group, an assay of \$250 being reported from a 3-ft. width at one point.

Tonopah.—The West End Consolidated Co. shipped 31 bars of bullion, valued at \$68,350, as the product of the final clean-up for April; most of the ore comes from the big stopes in the Ohio Tonopah ground.

UTAH

Alta.—Operations have been resumed at the Louise Mining Co.'s mine, according to R. O. Dobbs, manager. Most of the work at present is being done in a drift from the



Tonopah and Divide

raise from the Maggie tunnel. One lot of ore, averaging \$66 per ton, was shipped from this raise last year.

American Fork.—Development work has been resumed at the Globe Consolidated property, according to John Cleg-horn, manager. The face of the adit is now 500 ft. from the portal, and it is planned to drive this about 250 ft. farther.—About a month ago, operations were resumed by the American Leasing Co., which has a long-term lease on the Belorophon, the Silver Wave, and Live Yankee groups of claims, adjoining the Globe holdings. This work is under the management of C. B. Ferlin.

Bingham.—The Utah-Apex Mining Co. will file in the Circuit Court of Utah its exceptions to the accounting for damages which the Utah Consolidated Mining Co. submitted

in accordance with the Court's decree. The Utah-Apex claimed damages to the extent of \$2,500,000. The Utah Consolidated filed a brief, acknowledging it should pay \$611,390 as principal and \$47,591 as interest, or a total of \$658,982, or about 25% of the amount claimed by the Utah-Apex. At present the Utah-Apex has a small force on development work and the upkeep of its plant. According to local gossip, the company will resume mining and milling operations when lead reaches 5¢. per pound.

At the present time, about 600 men are employed in and around the mines of this camp, and the payroll is about \$75,000 per month. Many of the miners thrown out of employment by the mining companies have taken leases, and in most cases, they are earning more than ordinary wages.

The Montana-Bingham Mining Co. will increase shipments of low-grade copper ore to approximately 100 tons per day, according to an official statement. The company has been making a profit on shipments of high-grade copper ore, which average about eight carloads per month. These shipments averaged from 9 to 18.65% copper, with some silver and gold. Development operations are progressing favorably. A raise from the main adit is expected to reach the upper workings very shortly. A winze sunk from the adit is now at a depth of 240 ft., in ore all the way. An additional force of 20 men will be put to work on the mining of the low-grade copper ore.

Eureka.—The Chief Consolidated Mining Co. shipped 21,144 tons of ore during the first quarter of 1921, averaging 0.49 oz. gold, 35.68 oz. silver, and 17.24% lead. The average gross value per ton was \$40.62; smelting, freight, and sampling totaled \$17.86 per ton, leaving a net value of \$22.76 per ton. The total profit for the quarter was \$43,064. A dividend of 5¢. per share, or \$44,201, was paid. Development work during the period amounted to 1000 ft. Cecil Fitch, manager for the company, states that ore-reserves were fully maintained.

Ore-shipments for the week ending May 7 totaled 134 cars, as against 126 for the preceding period. The Tintic Standard shipped 50; Chief Consolidated, 32; Iron King, 16; Iron Blossom, 8; Dragon, 7; Eagle & Blue Bell, 6; Victoria, 4; Gemini, 3; Colorado, 3; Swansea, 2; Eureka Hill, Eureka Mines, and Mammoth, 1 each.

Drifting has been started on the 500-ft. level of the Lehi-Tintic property at North Tintic, according to Charles Zabriskie, manager. The drift is from a 500-ft. winze, which was sunk at a point several hundred feet from the portal of the adit.

The Eureka-Lily Mining Co. will resume operations on June 1. The holdings of this company adjoin those of the Tintic Standard. In order to begin work, an assessment of one cent per share has been levied. As only one shift will be employed, the proceeds of this assessment will be sufficient for five or six months work. Operations will be resumed on the 1400-ft. level, with the object of getting under high-grade orebodies found on the upper levels.

Kelton.—The Silver Hills Mining Co., whose property is 25 miles north of here, plans to resume work. W. J. Burridge, president, states that a shaft has been sunk to a depth of 180 ft. At 80 ft., the sulphide zone was entered and a 16-ft. deposit of ore was opened, averaging \$1 in gold, 15 oz. in silver, and 3% lead.

Moab.—The Utah Placer Mining Co. owns two groups of claims totaling 700 acres. Gravel from the Fishford group averages 60¢. in gold and 90¢. in platinum, while the second group averages \$1 in gold and 50¢. in platinum per yard. The ground will be mined during the coming summer.

Park City.—Shipments for the week ending May 7 totaled 1112 tons, of which the Judge companies shipped 690; Ontario Silver, 257; and the Silver King Coalition, 165, as compared with 1450 tons for the previous week. The Judge

companies have about 500 men on the payroll at the present time, which is probably the largest number employed by any metal-mining company in the State.

Washington County.—Development work has been stopped at the property of the Silver Reef Consolidated Mines Co. The company will centre its efforts on the completion of a mill, as sufficient ore has been developed to warrant it.

ARGENTINE

Buenos Aires.—It is said that as a result of the rich discoveries of oil in the Comodoro Rivadavia field, Argentina may become one of the world's great sources of fuel. Well No. 128, which came in on February 28 with an initial production of about 100 bbl. per hour, is continuing to flow at approximately the same amount. The Comodoro Rivadavia oil-producing area is situated in the Territory of Chubut, in the region called Patagonia, and is more than 600 miles south-west of Buenos Aires. It was discovered in 1907 when a deep test was being made in an effort to find a water-supply. The Government, exercising its ownership of mineral rights, set aside 12,500 acres of land in the district and began the work of exploring the field. Later another 12,500-acre tract was reserved. Since that time 128 wells have been sunk and production has gradually increased up to the present. In 1920 the total production was more than 1,000,000 bbl. The oil is heavy with small kerosene and gasoline content and is used principally as fuel-oil, being sold to a number of industries in the country. Drilling depths are between 1500 and 1800 ft. Until well No. 128 was brought in, all the wells had shown small production, although several of them were gushers and had an initial production that passed the 100-bbl. mark. Practically every well drilled found oil in paying quantities.

BRITISH COLUMBIA

Sandon.—The Silversmith Mines has purchased the Ivanhoe mill, equipment, and mill-site from the Minnesota Mining Co. and purposes to spend \$40,000 in remodeling and enlarging this mill, according to John B. White, president of the Silversmith company. This will give facilities for treating a larger tonnage of ore. The present mill has a capacity of 75 tons daily. The equipment in this mill will be moved to the Ivanhoe mill. Work on the 41,000-ft. tram to connect the mine and new mill is to start shortly.

Stewart.—The Red Cliff group of claims situated on Bear river is reported to have been taken over by R. W. Wood and A. B. Trites, who purpose doing development work this year. The outcrop on the Montrose claim contains gold and copper.—P. H. Graham, who has charge of the installation of an eleven-mile aerial tramway for the Premier Mining Co., which will transport ore and concentrate from that company's property to tidewater, has taken over personal direction of the work. The tramway, the route of which parallels the wagon-road and is approximately 11½ miles long, is the second longest of its kind on the American continent. There are to be 150 ordinary towers and twelve tension towers, as well as three angle-stations and two terminals. Mr. Graham also is to supervise the construction of ore-bunkers at the wharf; they will have a capacity of 4000 tons.

Trail.—Ore receipts in gross tons at the smelter of the Canadian Consolidated Mining & Smelting Co. from April 21 to 30 totaled 12,056 tons. Of this the company mines contributed 12,023 tons and the Sally, Beaverdell, 33 tons. This brings the total for the year up to 139,816 tons.

Vancouver.—A Vancouver branch of the Yukon Order of Pioneers has been formed. Membership is limited to those who entered the Northland prior to 1900. At the first banquet of the organization there were present many who had 'mushed' over the historic Chilcoot and White Pass trails to the goldfields. The company included three ex-

governors of the Territory, F. T. Congdon, Alex. Henderson, and Capt. George Black; two ex-mayors of Dawson City, Henry C. McAulay, the first to hold that office in the centre of the Yukon, and R. P. McLennan; and other former Northerners of distinction. One incident of the affair was the declaration by Edward C. Russell, of Seattle, grand president of the Y. O. O. P., that greater things than have been are to come out of the Yukon in the way of commercial development when "the solid silver ores of the Mayo and other sections are exploited".

MEXICO

Durango.—Herbert E. Hambleton, a well-known mining man of Durango, has taken up a group of claims known as Las Granadas, situated in the Guanacevi district. The

was shipping high-grade ore to the Velardena smelter, now closed down.

Monterrey.—Plans have been made by a syndicate of New York men, which purchased the Cadamena mines in the western part of the State or Chihuahua from Manuel Raynol, for the construction of an ore-reduction plant to handle the ores of the property.——Ralph L. Van der Nailen has been granted a concession by the Mexican government for the exploitation of large placer deposits in the States of Sinaloa and Sonora. It is stated that the concession embraces 8000 acres in the beds of four rivers and their tributaries. The rivers are the Yaqui, Fuerte, Mayo, and Sinaloa.

Torreon.—E. Kreklau, who has figured prominently in mining in the Velardena district for some years, has re-



Bedding Ore at the Cananea Smelter, in Sonora, Mexico

property lies contiguous to the Aguaje, Peru, and El Oro mines, producers of gold and silver ore.——The Consuela No. 6 is a new filing on six mining claims made by Alfred Espana in the same district. A prospect shaft is being sunk on a well-defined vein of gold-silver ore.

In the Topia district of the State of Durango Romulo Gamboa has added another group of claims to his holdings. The property is to be named La Trinidad; it is situated near the La Paloma property.

Agustin Castro, Governor of Durango, is in Mexico City conferring with Federal officials in an effort to relieve the hardships throughout the State caused by the general suspension of the principal mines and smelters which have been closed down. Governor Castro asserts that if sufficient cars can be furnished to bring in fuel and transport the ores from the mines to the smelters some will resume operations giving employment to a great many men.

Work at Los Libres mines in the Velardena mining district was suspended this week, and W. H. Williams, manager, has left for the United States. This property belongs to the American-Mexico Mining & Development Co. and

cently returned from a business trip to Eagle Pass, where he completed arrangements with Leon D. Brooks and associates to take a one-half interest in seven groups of mines. The properties included in the transaction are the U. S., U. S. Extension, Wa-Hu, America, Dolores, Mexico, and San Lorenzo. A company with a capital stock of \$100,000 is to be formed, with headquarters in Eagle Pass, to be known as the U. S.-Wa-Hu Mining Co. In the meantime capital has been advanced to begin active development. The ore from the U. S. and U. S. Extension will be hauled to the station by automobile trucks.

It is insistently rumored that both coal and oil have been discovered in the State of Durango a short distance west of this city. Samples sent to the United States for analysis have proved of such worth that geologists will soon arrive to make an investigation of the region.

ONTARIO

Cobalt.—Some old properties which have not been operated for a number of years are being re-opened in the Cobalt district. The Victory Silver Mines, formerly the

Hylands, will explore the Keewatin-dabase contact at a depth of about 400 ft. Arrangements are being made to re-open the Silver Cliff mine. The Casey Mountain Syndicate will resume work at once on its property in Casey township. Silver production from the Nipissing mine is averaging about \$5000 daily, while the total production in the district is at the rate of about \$12,000 daily. Cobalt oxide and cobalt metallies are being produced at a rate of about \$600,000 per year. Good ore has been encountered on the Balley Silver Mines in a raise from the 4th level. The Silver Bullion property in the Gowganda district is to be re-opened this month. Three machines are employed on the Keeley Silver Mines and at the 360-ft. level a vein is being opened up in which the silver content is from 25 to 30 oz. per ton across a width of about three feet. The Kirkland Lake Proprietary (1919), Ltd., has removed its main office from Cobalt to Kirkland Lake, where energy is to be directed toward re-opening the Tough-Oakes and the Burnside mines, both of which are controlled by this concern. The Mining Corporation of Canada has put a small force of men to work on its Buffalo property. Re-modeling of the reduction plant to increase the capacity from 200 to 300 tons is now nearly completed.

The Keeley Silver Mines has been re-opened and a force of 30 men is engaged in developing the main orbody at the 360-ft. level. No effort will be made this spring to operate the new 20-stamp mill unless the price of silver increases.

High-grade ore is being developed on the Castle property at Gowganda, and arrangements will be made this year to erect a mill to treat the medium-grade ore which occurs in close proximity to the high-grade ore-shoots.

Kirkland Lake.—The Wright-Hargraves mill went into operation on April 26 and has since been working smoothly, treating between 100 and 125 tons of ore daily. Its estimated capacity is 175 tons, but this amount will not be handled until underground work has been further advanced. The Lake Shore during March produced \$21,675 from the treatment of 1910 tons of ore. No. 1 vein has been cut south of the shaft at the 600-ft. level, where it shows a width of 12 ft. and is more heavily mineralized than on the 400-ft. level. A cross-cut on the 600-ft. level has entered the fracture in which vein No. 2 occurs. On the 400-ft. level a stope 350 ft. long and averaging 11 ft. wide has been opened, the ore in which averages \$28 per ton. Machinery to increase the capacity of the mill to 100 tons daily is on the way.

Larder Lake.—The new three-compartment shaft on the Kerr-Addison property of Canadian Associated Goldfields has reached a depth of 260 ft. Reports of high-grade finds on the property are confirmed. It is officially stated that the work of the past few months has been of importance in determining the character and continuity of the ore-shoots.

Ottawa.—A new amendment to the oil regulations provides that in view of difficulties in transportation the time fixed for the installation of machinery may be extended from one year from the date of the lease to a period not exceeding two years from that date.

Sault Ste. Marie.—Oil is reported to have been discovered on the Jennison farm six miles from the city.

YUKON

Mayo.—The Guggenheims are opening up new rich claims and are finding good ruby silver. The Northwest Corporation, a subsidiary company of the South American Gold Fields, has secured fifty claims. The opportunities for obtaining ground with small capital will be limited after next summer. Engineers for the Canadian Pacific Railway Co. are investigating property on the Christable creek slope of Keno hill, and others are prospecting the Rambler, Look-out, Stand To, Patterson, and Cameron mountains.

PERSONAL

The Editor invites members of the profession to send particulars of their work and appointments. The information is interesting to our readers.

William T. MacDonald is at Salt Lake City.

Clifford G. Dennis has returned to San Francisco.

Philip N. Moore has returned from Washington to St. Louis.

James A. Hancy has returned from Kantishna, Alaska, to Seattle.

Ross B. Hoffmann has returned to Oakland, California, from London.

A. J. Beaudette sailed from New Orleans on May 12 on his way to Colombia.

C. C. Brayton is visiting mining districts in Arizona, Montana, and Utah.

W. H. McKimney Jr., of the Belgian Congo, West Africa, is at Newark, New Jersey.

W. E. Thorne is on his way from New York to South Africa by way of London.

Walter E. Gaby is at Pachuca, Mexico; he will return to Tezuatlan in three months.

H. Laycock, who has been with the Rosario Mines, in Honduras, is at Berkeley, California.

Edward R. Knowles has joined the engineering firm of Murrie & Company, at 74 Broadway, New York.

H. J. Gundlach is general manager for the Mine & Smelter Supply Co., in place of W. L. Loveland, who has resigned.

Brokaw, Dixon, Donnelly, Garner & McKee have removed their offices from 90 West street to 120 Broadway, New York.

John M. Fox has opened an office as examining and operating mining engineer in the Holbrook building, San Francisco.

James P. Gaskill, of Los Angeles, sailed from San Francisco on May 17 on his way to the Copper River district, Alaska.

S. C. Thompson has been appointed consulting engineer to the Kirkland Proprietary Mines Ltd., operating in Ontario.

O. F. Riser has resigned as mill-superintendent for the Chino Copper Co. at Hurley, New Mexico. He is now at Salt Lake City.

C. P. Bowie, petroleum engineer for the U. S. Bureau of Mines, has returned to San Francisco from the Santa Maria oilfield, California.

James Irving, of Los Angeles, has made an examination and report on the properties of the Silver Dome Mining Co., in Yuma county, Arizona.

Stanly A. Easton, manager for the Bunker Hill & Sullivan M. & C. Co., has been appointed a member of the State Board of Education of Idaho by Governor D. W. Davis.

Frank T. Snell has resigned as general foreman for the Nevada Consolidated Copper Co. to become associated with the Trojan Powder Co., with offices in the H. W. Hellman building, Los Angeles.

A. G. McGregor, of Warren, Arizona, sailed from New York on May 11 for a six weeks trip to Peru, where he will inspect the new smelting work that he designed for the Cerro de Pasco Copper Corporation.

M. J. Gavin, oil-shale technologist of the U. S. Bureau of Mines at Salt Lake City, will give an address on May 24 at Chicago on 'Oil Shale and Its Value as a Fuel Resource' before the International Railway Fuel Association.

J. C. Dick has resigned as chief of the Natural Resources Subdivision of the Income Tax Unit at Washington, D. C., and has resumed his practice as consulting mining engineer, with offices in the Walker Bank building, at Salt Lake City.

Eastern Metal Market

New York, May 11.

A fairly strong tone pervades all the markets; in some prices are higher.

Foreign buying of copper has been active but domestic purchases are small. Prices are firmer.

The tin market is steady and quiet after a few days of activity.

Lead prices have advanced again and the market is strong.

The zinc market is exceedingly dull but prices are steady.

Antimony is unchanged.

IRON AND STEEL

After one of the quietest weeks of the year in the matter of new orders, the steel industry is more confirmed in the view that for some time it may look for a succession of hummocks and troughs, with no long continuance of either, says 'The Iron Age'. The more cheerful sentiment of the two preceding weeks did not improve orders booked to the degree expected.

British pig-iron output was only 60,300 tons in April and the month's total of steel ingots was but 68,400 tons—both showing the paralyzing effect of the coal strike. Current operation is at less than 10% of the rate for 1920.

COPPER

The buying for the Far East which has characterized the past two or three weeks has now been supplemented by purchases from several European countries. At the close of last week, buying by England, France, Germany, Italy, and China, as well as Japan, aggregated 4,000,000 to 5,000,000 lb. The foreign situation is much better and when the reparation matter is settled, it is expected that the Central Powers will be more active. Sales for foreign consumption are usually at a higher level than prevailing domestic prices. Activity in the part of domestic buyers is by no means brisk. Inquiry is better, however, and it is expected that if foreign buying continues it will have a beneficial effect on the domestic demand. Electrolytic copper is quoted at 12.75c., delivered, or 12.50c., New York, for early delivery, with as high as 13 to 13.25c. asked for shipment into July. The lower price of 12.62½c., delivered, has largely disappeared and the market is stronger. Lake copper is only moderately active at 13c., delivered, or 12.75c., New York.

TIN

Starting a week ago Saturday a fairly active buying movement in tin set in; this continued until the end of the day on May 4, or last Wednesday. Fairly liberal sales were made which were confined largely to two tin importers. While consumers were purchasers in volume, the greater portion was taken by one dealer. The positions as sold include May-June and July-August from the East, with 32c. bid at the close on May 4, but there were then no sellers. During the movement spot tin was largely neglected as well as closely held. About this time sharp advances were made in London, on Thursday, May 5, amounting to £6½ per ton, but this at once choked off purchasing on this side and was regarded as a wrong policy. Since then the market has been stagnant and it is believed that, had the rise in London been more gradual, there would have been much more buying by consumers here. Spot Straits tin has hovered around 33c., New York, most of the week with the quotations yesterday at 32.25c. The London market is higher than a week ago by about £5 per ton, the quotations yesterday having been £173 10s. for spot standard, £175 15s. for future standard, and £179 10s. for spot Straits. The Singapore

price Monday was £181 per ton c.i.f. London. Arrivals thus far this month have been 510 tons, with 1490 tons reported afloat.

LEAD

Two more advances have been made by the American Smelting & Refining Co. in the last week. On May 4 this producer raised its price to 4.75c., New York and St. Louis, and again yesterday a further advance was announced to 5c., both districts. The outside market had already reached this level. Buying has been good, but production and stocks are not heavy, which accounts in part for the market's strength. It is understood that the leading interest is not a seller at present, disposing of its May shipment metal at its average price for May. Outsiders are selling at 5c., New York, and taking most of the business.

ZINC

There has been no revival from the dullness into which the market fell about a week ago. Demand has fallen off, if anything, but prices are fairly steady at 4.95c., St. Louis, or 5.45c., New York, for prime Western for early delivery. A small lot is said to have sold at slightly under this, but a large majority of the producers adhere firmly to the above quotations. Large sellers are not eager to part with their output. The ore position is such that, because of higher prices, stocks have not been greatly exhausted by the advance recently in the metal.

ANTIMONY

There has been no change in conditions or prices. Wholesale lots for early delivery are quoted at 5.25c., New York, duty paid.

ALUMINUM

The market is unchanged and inactive at 28c. per pound f.o.b. plant, for virgin metal, 98 to 99% pure, from the leading producers in wholesale lots for early delivery, while the same grade can be bought from other sellers at 23 to 23.50c., New York.

ORES

Tungsten: No changes are noted but the market is fairly firm. Sellers generally are not inclined to sell pending tariff bill settlements. Quotations are largely nominal at \$3.25 per unit for Chinese ore with high-grade Bolivian ore at about \$4 per unit.

Ferro-tungsten is unchanged at 58c. per pound of contained metal in lump alloy, guaranteed as to purity.

Molybdenum: Quotations are nominally unchanged in a dull market at 55 to 60c. per pound of MoS₂ in regular concentrate.

Manganese: Offerings below prevailing quotations are heard of, but there is no business reported. Prices are nominal at 25 to 30c. per unit, seaboard.

Manganese-Iron Alloys: There is almost no demand for ferro-manganese, but the market for spiegeleisen is more active. Two or more carloads have been sold and there are inquiries before the market involving about 500 tons. The 20% grade is selling at \$32, furnace. Quotations for ferro-manganese are unchanged at \$90, delivered, for the American and \$100, seaboard, for the British. The ferro-manganese production in April, according to 'The Iron Age', was 9466 gross tons, which is about half the monthly average for the first quarter. The spiegeleisen production last month was 14,744 tons, or much above the monthly average last year.

THE METAL MARKET



METAL PRICES

San Francisco, May 17

Aluminum-dust, cents per pound.....	75
Antimony, cents per pound.....	7.50
Copper, electrolytic, cents per pound.....	13-13.50
Lead, pig, cents per pound.....	5.25-5.25
Platinum, pure, per ounce.....	\$75
Platinum, 10% Iridium, per ounce.....	\$105
Quicksilver, per flask of 75 lb.....	\$50
Spelter, cents per pound.....	7.50
Zinc-dust, cents per pound.....	12.50-15.00

EASTERN METAL MARKET

(By wire from New York)

May 16.—Copper is quiet and firm. Lead is dull but steady. Zinc is inactive but easy.

SILVER

Below are given official or ticker quotations for silver in the open market as distinguished from the fixed price obtainable for metal produced, smelted, and refined exclusively within the United States. Under the terms of the Pittman Act such silver will be purchased by the United States Mint at \$1 per ounce, subject to certain small charges which vary slightly but amount to approximately three-eighths of one cent. The equivalent of dollar silver (1000 fine) in British currency is 48.65 pence per ounce (925 fine), calculated at the normal rate of exchange.

Date	New York	London	Average week ending	Cents	Pence
May 10.....	61.37	35.00	Apr. 4.....	56.02	32.98
" 11.....	60.50	34.50	" 11.....	58.00	33.54
" 12.....	60.87	34.50	" 18.....	60.18	34.83
" 13.....	60.25	34.25	" 25.....	60.22	34.77
" 14.....	59.75	33.87	May 2.....	60.68	34.70
" 15 Sunday.....			" 9.....	61.58	35.08
" 16.....	59.75	Holiday	" 16.....	60.41	34.42

Date	1919	1920	1921	1919	1920	1921
Jan.	11.12	132.77	65.85	July	106.36	92.04
Feb.	101.12	131.27	59.55	Aug.	111.35	96.23
Mch.	101.12	123.70	56.08	Sept.	113.92	93.06
Apr.	101.12	110.56	59.33	Oct.	119.10	83.48
May	107.23	102.69	....	Nov.	127.57	77.73
June	110.50	80.84	....	Dec.	131.92	64.78

COPPER

Prices of electrolytic, in cents per pound.

Date				Average week ending			
May 10.....	12.50			Apr. 11.....	12.08		
" 11.....	12.50			" 11.....	12.50		
" 12.....	12.50			" 18.....	12.50		
" 13.....	12.50			" 25.....	12.50		
" 14.....	12.50			May 2.....	12.37		
" 15 Sunday.....				" 9.....	12.46		
" 16.....	12.50			" 16.....	12.50		
Monthly averages							
	1919	1920	1921		1919	1920	1921
Jan.	20.43	19.25	12.94	July	20.82	19.00
Feb.	17.34	19.05	12.84	Aug.	22.51	19.00
Mch.	15.05	18.49	12.20	Sept.	22.10	18.75
Apr.	15.23	19.23	12.50	Oct.	21.66	16.53
May	15.91	19.05	Nov.	20.45	14.63
June	17.53	19.00	Dec.	18.55	13.18

LEAD

Lead is quoted in cents per pound, New York delivery.

Date	cents per pound		Average week ending			
May 10.....	5.00		Apr. 4.....	4.39		
" 11.....	5.20		" 11.....	4.25		
" 12.....	5.20		" 18.....	4.30		
" 13.....	5.15		" 25.....	4.25		
" 14.....	5.15		May 2.....	4.45		
" 15 Sunday.....			" 9.....	4.85		
" 16.....	5.15		" 16.....	5.14		
Monthly averages						
	1919	1920	1921	1919	1920	1921
Jan.	5.60	8.65	4.96	July	5.53	8.63
Feb.	5.13	8.88	4.54	Aug.	5.78	9.03
Mch.	5.24	9.22	4.06	Sept.	6.02	8.08
Apr.	5.05	8.78	4.32	Oct.	6.40	7.28
May	5.04	8.55	Nov.	6.70	6.37
June	5.32	8.43	Dec.	7.12	4.76

TIN

Prices in New York, in cents per pound.

Date	1919	1920	1921	1919	1920	1921
Jan.	71.50	62.74	35.94	July	70.11	49.29
Feb.	72.44	59.87	32.16	Aug.	62.20	47.60
Mch.	72.50	61.92	28.87	Sept.	55.79	44.43
Apr.	72.50	62.17	30.36	Oct.	54.82	40.47
May	72.50	54.99	....	Nov.	54.17	36.97
June	71.83	48.33	....	Dec.	54.94	34.12

ZINC

Zinc is quoted as spelter, standard Western brands, New York delivery, in cents per pound.

Date			Average week ending	
May 10.....	5.45	Apr. 4.....	5.16	
" 11.....	5.40	" 11.....	5.15	
" 12.....	5.40	" 18.....	5.14	
" 13.....	5.40	" 25.....	5.20	
" 14.....	5.40	May 2.....	5.49	
" 15 Sunday.....		" 9.....	5.45	
" 16.....	5.40	" 16.....	5.41	

Monthly averages							
	1919	1920	1921		1919	1920	1921
Jan.	7.44	9.56	5.80	July	7.78	8.18	....
Feb.	6.71	9.15	5.34	Aug.	7.81	8.31	....
Mch.	6.53	8.93	5.19	Sept.	7.57	7.84	....
Apr.	6.49	8.70	5.33	Oct.	7.82	7.50	....
May	6.43	8.07	....	Nov.	8.12	6.78	....
June	6.31	7.02	....	Dec.	8.69	6.03	....

Monthly averages

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, according to quantity. Prices, in dollars per flask of 75 pounds.

Date	1919	1920	1921	1919	1920	1921
Jan.	103.75	80.00	50.00	July	100.00	88.00
Feb.	90.00	81.00	48.75	Aug.	103.00	85.00
Mch.	72.80	87.00	45.88	Sept.	102.00	75.00
Apr.	73.12	100.00	46.00	Oct.	86.00	71.00
May	84.80	87.00	....	Nov.	78.00	50.00
June	94.40	85.00	....	Dec.	95.00	52.50

OUR TRADE WITH GERMANY EXCEEDS THAT PRECEDING THE WAR

Whatever may be the general effect of the reparations agreement upon the general trade of Germany it is quite apparent, says a statement by The National City Bank of New York, that our sales in that country in the fiscal year 1921 will be bigger than in any year in the history of the trade between the two countries.

Prior to the War we were selling to Germany about \$300,000,000 worth of merchandise per annum, making the highest record in 1913, \$352,000,000, having ranged from \$258,000,000 in 1910 up to \$352,000,000 in 1913, while the figures thus far received on our trade for the fiscal year 1921 indicate that the total of exports to Germany will reach or perhaps exceed \$400,000,000. In the nine months ending with March 1921 they were \$312,000,000, or more than to any European countries except Great Britain and France, and were running in recent months at over a million dollars per day, suggesting that the total for the twelve months ending with June 30 will probably exceed \$400,000,000 as against the high water mark of \$352,000,000 in 1913.

On the import side the total from Germany in the fiscal year 1921 will probably amount to about \$100,000,000 against \$185,000,000 in the year immediately preceding the War. While nothing can yet be determined as to the effect of the proposed tax of 26% on the value of Germany's exports, there is reason to believe that the merchandise which she is sending to us will total for the fiscal year 1921 about \$100,000,000 in value, the total for the latest available month, March, having been \$7,368,000 as against only \$4,952,000 in February 1921, thus indicating a rapid growth in our imports from Germany.

The principal articles forming this newly developing trade with Germany are, on the export side, food-stuffs, raw cotton, copper, and other manufacturing material, and on the import side, coal-tar dyes, potash chiefly for use as fertilizers, furs, glassware, gloves, musical instruments, sugar beet seeds, a small quantity of beet sugar, toys, wood pulp, and certain cotton manufactures. Of raw cotton the exports to Germany for the nine months for which figures are now available were greater than to any other country except the United Kingdom and amounted in value to \$87,000,000; copper, 91,000,000 lb., valued at \$14,000,000, and only exceeded by the shipments to France which were \$16,000,000; while of food her takings were of flour which amounted in the nine months ending with March to \$13,000,000, while of wheat and flour her takings in the nine months ending with March were approximately \$57,000,000.

Of especial interest are the figures showing the principal articles which we are now importing from that country. Figures of the Department of Commerce show that our imports from Germany in the calendar year 1920 included \$8,825,000 worth of muriate of potash, \$7,084,000 of manure salts, \$3,383,000 of kainite, a fertilizer, \$5,436,000 of beet sugar, \$1,565,000 worth of coal-tar colors and dyes, \$3,056,000 worth of furs, and \$1,190,000 worth of toys of which dolls and parts thereof were \$1,051,000.

MONEY AND EXCHANGE

Foreign quotations on May 17 are as follows:

Sterling, dollars: Cable	4.00%
" Demand	4.01 1/4
Francs, cents: Cable	8.58
" Demand	8.61
Lire, cents: Demand	5.65
Marks, cents	1.80

Company Reports

CAMP BIRD, LIMITED

Report for the year ended June 30, 1920.

Property: Mine and mill in Colorado.

Operating Officials: William J. Cox, general manager; T. H. Woods, superintendent; J. T. Boast, mine foreman.

Financial: Profit for the year, £64,717 14s.; dividends, £45,473 15s.; balance forward, £37,440 5s. 1d.

Development: 4699 feet.

U. S. SMELTING, REFINING & MINING COMPANY

Report for the year ended December 31, 1920.

Operating Officials: C. E. Allen, D. D. Muir Jr., W. A. Howard, O. J. Egleston, R. E. Hanley, D. R. Muir, E. L. Young, M. W. Beckwith, A. P. Anderson, G. H. Clevenger.

Financial: Earnings, \$6,777,000.07; profits, \$2,909,274.82; dividends, \$1,702,225 and \$1,755,575.

General: The silver and gold output of the Cia. de Real del Monte y Pachuca was the largest in its history. Developments at the new properties, including the Arevelo, are favorable.

SANTA GERTRUDIS COMPANY, LIMITED

Report for the year ended June 30, 1920.

Property: Mine and mill at Pachuca, Mexico.

Operating Officials: H. Rose, managing director; C. A. Lantz, general manager; F. H. Walsh, general superintendent; J. F. Berry, mine superintendent; W. E. Crawford, milling superintendent.

Financial: Profit for the year, £172,384 6s. 4d.; dividends and directors' remuneration, £151,723 16s. 10d.; balance carried forward, £28,982 11s. 11d.

General: The company's holding on the Compañía de Santa Gertrudis, S. A., and the Compañía Beneficiadora de Pachuca, S. A., remains unchanged.

NORTH BUTTE MINING COMPANY

Report for the year ended December 31, 1920.

Property: Mines at Butte, Montana.

Operating Officials: N. B. Braley, general manager; L. D. Frink, superintendent.

Financial: Income, \$3,101,404.36; expenditures, \$3,677,637.54; deficit, \$576,233.18.

Production: 312,982 tons, for 16,576,510 lb. copper, 693,633.02 oz. silver, and 1004 oz. gold; 2235 tons from the BIRTHA mine produced 90,309 lb. copper.

Development: Granite Mountain mine, 19,100 ft.; Sarsfield mine, 3002 ft.; BIRTHA mine, 269 feet.

General: Operating efficiency has been maintained in a satisfactory manner; a larger footage of development was done in a smaller number of shifts.

INSPIRATION CONSOLIDATED COPPER COMPANY

Report for the year ended December 31, 1920.

Property: Mine and mill at Miami, Arizona.

Operating Official: T. H. O'Brien, general manager.

Financial: From sales of copper, \$10,033,706.61; net income for year, \$2,294,276.08; dividends paid, \$4,136,884.50.

Development: 17.17 miles; no additional ore was developed.

Production: Milled, 5,078,338 tons assaying 1.139% copper; tailing assayed 0.320% copper; total production of copper, 79,453,740 lb. at a cost of 14.173c. per pound.

General: During the year two additional Oliver filters were erected. Experiments in leaching and flotation of mixed ores were discontinued. The results of these tests gave satisfactory assurance that the ores are amenable to

such treatment. There was no change in the wage scale of the Globe-Miami district during the year; wages of all employees of the company were reduced \$1 per shift on January 1, 1921. Freight on copper to the refineries remains at more than 100% higher than pre-War cost.

YUKON GOLD COMPANY

Report for the year ended December 31, 1920.

Property: California and Idaho; Jarbidge, Nevada; Yukon Territory; Federated Malay States.

Operating Officials: O. B. Perry, general manager; C. H. Munro and J. B. Newsom, examining engineers in Malaya.

Financial: Total production, \$1,325,036.69; net operating income, \$304,387.05; net deficit for the year, \$393,223.47.

Production: Dawson dredging, 1,226,578 cu. yd. for \$415,030; California dredging, 4,900,726 cu. yd. for \$494,490; Idaho dredging, 1,295,900 cu. yd. for \$96,332; Dawson hydraulics, 1,702,264 cu. yd. for \$284,969; Nevada lode mines, 41,248 tons for \$354,360; Mayo silver lead mines, 875 tons for 199 oz. silver and 60% lead.

General: The total developed acreage of tin fields in the Malay States is reported to contain 95,000,000 lb. of recoverable tin.

TONOPAH BELMONT DEVELOPMENT COMPANY

Report for the year ended December 31, 1920.

Property: Mines and mills at Tonopah, Nevada.

Operating Officials: F. Bradshaw, general manager; A. Silver, superintendent of milling; L. R. Robins, superintendent, Tonopah; W. H. Royston, mill superintendent, Tonopah; O. McCraney, superintendent, Shawmut.

Financial: Net earnings from the operation of the mine and mill, \$457,826.49; total credits, \$662,358.23; net profit for the year, \$603,146.72; dividends, \$150,000; paid January 1, 1921, \$75,000, April 1, 1921, \$75,000.

Production: The Tonopah mill treated 158,634 tons of ore for a recovery of 94.65% of the gold and 92.22% of the silver.

Ore-Reserves: 124,757 tons, positive, at the Belmont mine.

General: All the silver produced from the Belmont mine has, since the Pittman Act went into effect, been sold to the Government. The ore-reserves value is based on silver at \$1 per ounce; it would be materially reduced should this price not be maintained by the Government.

MIAMI COPPER COMPANY

Report for the year ended December 31, 1920.

Property: Mines and mills at Miami, Arizona.

Operating Officials: F. W. MacLennan, general manager; J. H. Hensley Jr., mine superintendent; F. W. Solomon, mill superintendent; R. B. Yerxa, assistant mill superintendent.

Financial: Net earnings, \$2,888,479; dividends, \$1,494,228.

Production: Ore milled, 1,501,958 tons; copper produced, 55,581,328 lb. for a total cost of \$0.08177 per pound.

Development: 41,925 ft.; ore-reserves, 10,723,410 tons at 2.26%; 36,000,000 at 1.06%; and 6,000,000 tons at 2%.

General: J. Parke Channing, in his report, states that the caving method of mining became a matter of routine during the year, with a reduction of mining cost of 24 cents as compared with 1919. Milling cost was reduced 10 cents, and other reductions brought the total cost at the mine to 39 cents below that of 1919, or about 1 cent per pound of copper produced. Development in the lower part of the main orebody during the year was extensive and resulted in adding about 1,500,000 tons to the previous estimate, with a slight lowering of the grade.

Book Reviews

Gas Torch and Thermit Welding. By Ethan Viall. Pp. 425, ill., index. McGraw-Hill Book Co., Inc., New York. For sale by 'Mining and Scientific Press', San Francisco. Price, \$4.

Electric Welding. By Ethan Viall. Pp. 399, ill., index. McGraw-Hill Book Co., Inc., New York. For sale by 'Mining and Scientific Press', San Francisco. Price, \$4.

Besides being by the same author, these books concern the two principal divisions of what is coming to be called auto-genous welding, this term including all welding other than forge-welding. They are therefore companion volumes and may well be discussed together. Mr. Viall has been on the staff of the 'American Machinist' for several years, and has been editor for the past year and a half. He has written several books in the past few years, and has engaged in many other useful activities. Furthermore, while a man of great ability, he is not a superman, and probably requires some time each night for sleep. The arts with which these books are concerned are relatively new; progress has been rapid.

Under the conditions outlined above, we would naturally expect to find errors, some small, some important, that had been overlooked in the haste of compilation, and our expectations would be verified. For instance, on page 74 of 'Gas Torch and Thermit Welding', appears the statement, "Cast-iron cannot be satisfactorily cut with a gas-torch." On pages 267-273 of the same volume appears the full report of the success of Stuart Plumley and F. J. Napolitan, of the Davis-Bournonville Co., in cutting cast-iron.

Under these conditions also, we would expect to find reports of the experience of individual investigators and operators, as given in magazine articles, also descriptions of apparatus and records of performance as furnished by the commercial companies, and here also we would not be disappointed. If, however, we continued our study, and sought thorough and impartial presentation of both sides of disputed questions regarding apparatus or practice, we would find it lacking. For instance, there is nothing in the book on electric welding to help a man who is uncertain whether to buy a direct- or an alternating-current welder. It is true that support of the claims of either side of this disputed question would be out of place, but it is in helping the individual in solving his own particular problem in such questions that one of the most important services of a technical treatise lies. And it is just here that the books in question are again found wanting. Progress in the arts covered may be so rapid that the publication of a really standard treatise is still impossible, but it would be entirely possible to present the material available in such a manner as to inform the reader fully as to the progress that has been made to date. This has not been done.

However, both books will be useful to those engaged in, or interested in, welding. There is a large amount of valuable material that has not appeared before in book form. In fact, practically the entire contents of both books are valuable, and the illustrations are excellent. But the material is poorly edited and incomplete. A. T. P.

Gasoline and Other Motor Fuels. By Carleton Ellis and Joseph V. Meigs. Pp. 670, ill., index. D. Van Nostrand Co., New York. For sale by 'Mining and Scientific Press', San Francisco. Price, \$10.

The production of motor fuels has become, almost overnight, one of the most important, if not the most important part of the business of petroleum refining, and processes have also been developed for obtaining motor fuels from other substances. In the present volume a general discussion of refinery methods lays the foundation for a detailed description of cracking processes, which occupies nearly half

the book, and includes those processes that have been described only in patent applications as well as those that have been demonstrated in practice to have a commercial value. The production of motor fuels from gases, from oil-shale, and from asphalts and cannel coal is also discussed, as well as the production and use of alcohol and benzol in engines. There are two appendixes, one containing general statistics of the petroleum industry, and one discussing the by-product coke industry. The treatise will be a valuable reference book for anyone engaged in the distillation of motor fuels or in the design of internal-combustion engines.

Thermodynamics and Chemistry. By Frank H. MacDougall. John Wiley & Sons, New York. For sale by 'Mining and Scientific Press'. Price, \$5.50.

This book has been written to meet the needs of advanced students of chemistry. Although a course of thermodynamics is indispensable to students of physical chemistry, it is no less desirable for the organic chemist, who finds that he must make use of physico-chemical methods and laws, the full significance of which will hardly be clear to one who is not familiar with their thermodynamic foundations. The contents of the book are as follows: Temperature; actual gases; heat; first law of thermodynamics; application of the first law; thermo-chemistry; second law of thermodynamics; deductions from the first and second laws; thermodynamic functions and equilibrium; fusion, evaporation, and sublimation; the phase rule; application of the phase rule; chemical equilibrium; electromotive force; surface tension and adsorption; radiation; the quantum theory; the Nernst heat theorem.

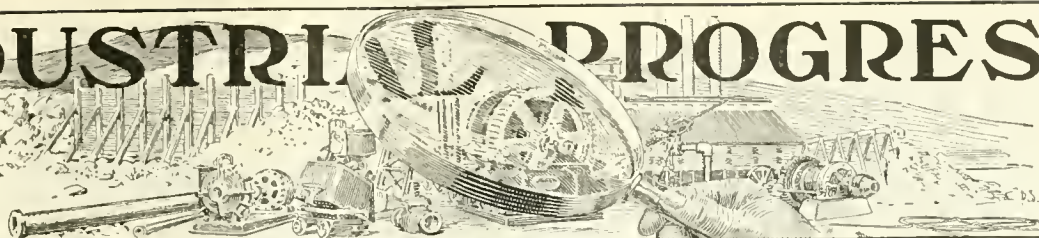
The Recovery of Nitrate from Chilean Caliche. By A. W. Allen. London, Chas. Griffin & Co., Ltd., Exeter street, Strand, W.C.2. Price, 6s.

The purpose of this booklet is to point a way to a more economical and efficient process, which preserves the simplicity of the Shanks system and, at the same time, permits of the complete treatment, to a satisfactory and logical conclusion, of material that is now considered valueless. The monograph includes a description and a criticism of the extraction and crystallization stages of the Shanks process, together with an analysis of the results of the present method of treatment. Features of desirability in an alternative scheme are discussed, as a preliminary to a description of the new process. Other subjects dealt with include the heating of nitrate solutions, the production of commercial nitrate from liquors extracted, the evaporation of water from nitrate solutions, and the use of the grainer for evaporation and crystallization purposes. A vocabulary of terms used in Chilean nitrate technology is appended.

Technical Methods of Analysis. Edited by R. C. Griffin. New York: McGraw-Hill Book Co., Inc. Pp. 666, 5½ by 8, ill. For sale by 'Mining and Scientific Press'. Price, \$6.

This treatise contains a representative selection of analytical methods that have been adopted as standard in the laboratories of Arthur D. Little, Inc. The methods described have been used and proved as satisfactory, or are standard procedures that have been accepted as reliable elsewhere. The book is remarkably complete, the subjects dealt with including the preparation of reagents, general inorganic and organic analysis, the analysis of metals, paints, oils, fats, waxes, soaps, fuel, wood, paper, textiles, and foodstuffs. Methods for the analysis of a number of miscellaneous substances are added, and the book concludes with a series of tables, with analytical factors and volumetric solutions; it has been written to conform to a standard style throughout, it has been carefully edited, and it is a creditable addition to the McGraw-Hill International Chemical Series. It should be recognized as an essential in every well-appointed laboratory.

INDUSTRIAL PROGRESS



INFORMATION FURNISHED BY MANUFACTURERS

SULLIVAN DRILL-SHARPENERS

The drill-sharpener illustrated herewith is a compressed-air machine for making rock-drill and hammer-drill bits by hammering.

Much deserved emphasis has been laid, in the past four or five years, on the importance of proper drill-bits. This cannot be too strongly urged. No matter how carefully the drills have been selected for the work to be done, or how efficient they may be, poor drill-steel, steel improperly forged or tempered, or bits of unsuitable shape, or not uniform in gauge, will nullify the excellence of the drilling machines. It may be truly said that the entire mining organ-

3. Uniformity: Bits are perfect in shape, with all wings of the specified length, thickness, and angle of cutting edge. Bits are made to the exact gauges called for, and the steels in a set 'follow' in the hole, ensuring steady progress and reducing the danger of stuck bits, with the resulting delay and wear and tear on the drill.

These advantages and their stimulating effect on drilling progress are so important that the mechanical drill-sharpener has come to be regarded as a part of a drilling outfit almost as essential as the steel itself. The variety of forge-shop work, aside from making bits and shanks, accomplished on a sharpening machine, also adds to its practical value. The Sullivan sharpener consists essentially of a clamp or vise, an upsetting hammer, and a swaging hammer, mounted on one compact frame.

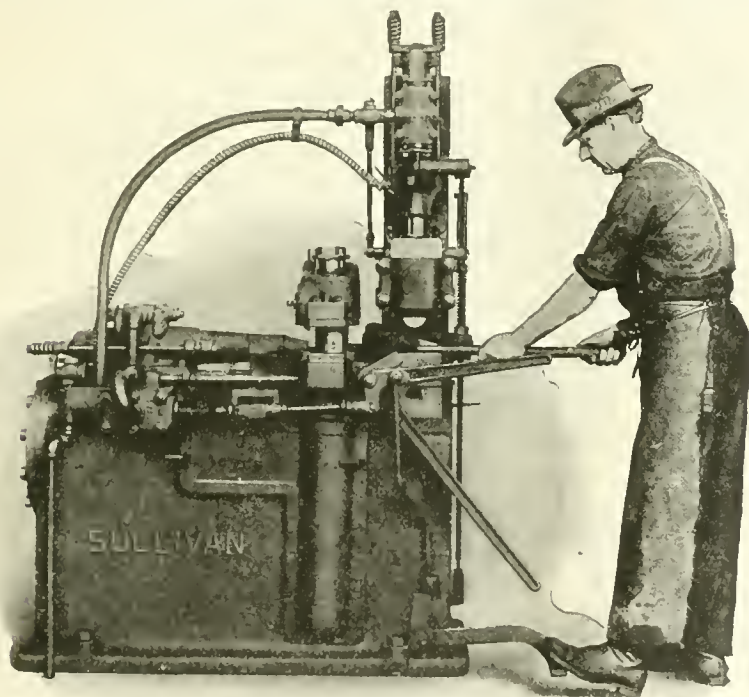
The especial advantages and features of Sullivan sharpeners may be summarized as follows:

1. Steel Quality: Gradual hammer-action preserves the quality of the steel and adds strength and toughness, while a
2. Low Forging-Heat is sufficient for proper working. The highest carbon steel is handled by this method without danger of burning.
3. Accuracy: The dies used for upsetting and gauging the steel ensure accurate and exactly uniform work. All bits are correctly gauged and are perfect in shape.
4. High Capacity: New bits may be made from bar-stock in one minute or less. Ordinary dull bits may be re-sharpened at the rate of 100 to 140 per hour.
5. The Variety of Work that may be performed on these machines.
6. Air-Power Economy: Air is used only while the sharpener is actually at work.
7. Compactness: The quick-acting air-vise eliminates long frames and tail blocks for holding the steel.
8. Convenience and ease of operation.
9. Reliability, ensuring continuous operation,

due to abundant strength and excellence of materials and construction.

10. Increased over-all drilling efficiency results from the improved quality of the steel, the reduction in bit breakage, and the reduction of wear and tear on the drills with its consequent delays.

Bits forged by the Sullivan 'all-hammer' process cut faster and farther and lose their edge and gauge less rapidly than bits made and sharpened by other methods. Old drillmen know, and tests have demonstrated repeatedly, that a bit will cut more feet of hole after it has been re-sharpened a few times under the blacksmith's hammer, than when made up for the first time. This is simply an example of the well-known fact that hammering not merely does not injure the quality of steel, when properly heated, but that it actually refines the metal, imparts to it a closer, more



Swaging a Bit With a Sullivan Drill-Sharpener

ization is pyramided on the drill-bit. Poor bits mean lost holes, undue drill wear and breakage, delay in repairing them, loss of time and curtailment of output. There is no better insurance for satisfactory progress or production than an adequate supply of good drill steel, properly sharpened, shanked, and tempered. A small investment for modern blacksmith-shop equipment, a little thought spent in arranging it systematically, and a policy of encouragement toward the smith and his helpers will pay large returns in improved drilling efficiency.

Advantages of machine-forging of drill-bits include:

1. Rapidity: The drills and their operators are not left idle for lack of sharp steel.
2. Labor Economy: A smith and a helper can handle as much steel on a modern sharpener as several crews sharpening by hand.

regular, structure, and renders it better capable of resisting shock and strain.

The bit is not upset to final shape and gauge at one operation, nor are the wings drawn out to final thickness and form all at once. The bit is upset a little in the horizontal hammer, then drawn out a little under the vertical hammer. These processes are alternated until a perfect bit is formed, in accordance with the best accepted methods of hammer-working steel. Further, distributing the work in this manner eliminates the possibility of raising fins on the edges and corners of the bit. If the upsetting is completed at one time, or the wings drawn out all at once, weakening strains are imposed on the steel, and its structure is distorted. The convenient arrangement of the working parts in the Sullivan sharpener permits this alternation to be rapidly accomplished and the bit properly worked, under the eye of the operator.

The heats required for proper handling of the steel in the Sullivan sharpener are moderate, ranging from 1500° to 1750°F., and high-carbon steel runs no danger of having its carbon content burned out during the process of sharpening. Not only this, but the steel may be worked longer, that is, at a lower heat, than is possible if methods other than hammering are employed; and the steel is not injured by such work. One heat is sufficient for nearly all processes performed by Sullivan sharpeners.

Proper heating of the steel is very important. When the customer has gone to the trouble and expense of determining the kind of steel that will give him the best service, and has secured this steel from the manufacturer, the mistake should not be made of employing sharpening methods that involve detriment to the steel by irregular or dangerous temperatures. When a bit has once been burned, its life and cutting power cannot be restored. A crumbling edge and rapid wearing or chipping of the corners are evidences of this damage; and this means decreased drilling speed, loss of drill-runners' time, and increased handling, labor for the blacksmith, and steel cost, due to the necessity of cutting off the burned bit entirely and making a new one.

The way to avoid such losses in material and efficiency is, first, to employ a sharpening machine, such as the Sullivan, which does not require dangerous heats for its successful operation; and, second, to provide a forge or furnace for heating the steel, which may be regulated so that overheating is impossible.

There are on the market oil- and gas-furnaces, with proper regulating devices, that provide a quick uniform heat and are convenient and economical of fuel. Such an outfit is a great improvement over a coal forge, in which it is almost impossible to keep the heat uniform while even one lot of steel is being heated, and in which the judgment and attention of the smith is the only protection against overheating.

In any case in which the amount of steel to be sharpened is sufficient to require the installation of a sharpener, it would seem exceedingly wise to purchase such a furnace. The expense is comparatively small, and the results gained in steel saving and increased drilling efficiency will pay for the investment many times over. The Sullivan drill-steel furnace has been designed especially for this service, and is securing remarkable results along the lines suggested above.

COMMERCIAL PARAGRAPHS

The Chicago branch store of the Lunkenheimer Company has been moved from 185 North Dearborn street, to 568 West Washington boulevard.

The Stearns-Roger Manufacturing Co., of Denver, has been awarded by the Catlin Oil-Shale Products Co. a contract for new equipment for its plant at Elko, Nevada, including two large gas-producers, 12½ ft. in diameter. It is

understood that the design of this apparatus has been completed and that the work of construction will be started immediately in the shops of the Stearns-Roger company at Pueblo.

Rickard & Company, Incorporated, is the new corporate name for Rickard & Sloan, specialists in industrial and technical advertising. The office will continue to be at 25 Spruce St., New York.

Leslie H. Allen, who has recently been with Fred T. Ley & Co., has joined the staff of the Portland Cement Association, 111 West Washington street, Chicago, as assistant manager of the Cement Products Bureau.

The George H. Gibson Co., consulting engineers specializing in commercial research and advertising of technical products, has moved its offices in New York from the Tribune building to the Hide and Leather building at 100 Gold street.

The Hardinge Company, whose New York office is at 120 Broadway, announces the publication of the sixth of its series of 'Grinding Data Bulletins'. This Bulletin presents interesting data on the operation of the large-sized Hardinge mills in the mining field, not only where stage reduction is the custom, but also where the single-stage method is in use. The whole series of bulletins embodies information on Hardinge mills and other types of grinders, not only in the mining field, but in the industrial field as well.

The Air Reduction Sales Co., manufacturer of 'Airco' oxygen, acetylene, and welding and cutting-apparatus, has moved its executive offices from 120 Broadway and 160 Fifth avenue to 342 Madison avenue, New York. This move to uptown New York comes as a result of the company's outgrowing its former quarters. The concentration of all its general office departments in one building, it is thought, will make for more convenience and efficiency. Coincident with the announcement of this change is another to the effect that the New York district office will be situated at the Airco factory, 191 Pacific Avenue, Jersey City. All correspondence and other communications heretofore directed to the district office should in the future be sent to the new address.

Homer J. Forsythe, manager of the construction division of the engineering department of the du Pont Company, has been transferred to the position of assistant general manager for the Hyatt Roller Bearing Co., of Newark, New Jersey, a subsidiary of the General Motors Corporation. Mr. Forsythe was selected for this important position because of his wide experience in machine-shop work. During the War he was made manager of the combined Wilmington shops, which were one of the major divisions of the duPont Engineering Co.'s activities in the construction of material for the war plants. At the end of the War he was promoted to manager of the construction division of the engineering department, which position he held until his recent transfer.

Bulletin No. 223, issued by the W. S. Rockwell Co., illustrates various types of burners for the use of oil- and gas-fuels for industrial heating. Emphasis is laid on the fact that the real question is not alone one of burner selection, but rather the successful conduct of a heating or heat-treating operation as measured by the cost of production of a quality product. The real 'efficiency' of a burner; the choice of type and size to suit the kind and pressure of the fuel and atomizing element; methods of attaching burner-plates; prices of different sizes in each type of burner; a chart showing the comparative cost per million B.t.u. at unit prices—these features will no doubt interest those readers who wish to keep in touch with developments relating to fuel and methods and means of utilizing it to the best advantage.



T. A. RICKARD, Editor

SILVER coinage is again to come into its own in Russia, the Soviet government having authorized action in that direction; a complete change of policy, therefore, is in evidence. It was not so long ago that the bolsheviks explained that money of any kind was unnecessary in a country that was governed and controlled by the 'workers'. The change of front in Russia is apparently due to the peasants, who have become increasingly distrustful of the ruble notes, which have an absurdly low purchasing power.

DEEP regret will be felt by many of those engaged in mining that Franklin K. Lane's useful life should have ended so soon. The letter that he wrote just after he had undergone a severe surgical operation, and when the grim ferryman seemed yet to be beckoning him, is of poignant interest to his friends. He spoke of his early career and referred to the fact that he had escaped more than once from being shot while engaged as "a newspaper man". Whereupon he remarked with deep seriousness: "There must be public concern in what is printed as well as the truth, to justify it. That is something the newspapers should get to know in this country".

FAIRLY healthy conditions in the mining of precious metals in Mexico are indicated by the following statistics, those for 1920 having been issued recently by the Mexican Department of Mines:

	Gold		Silver	
	Kilogrammes	Ounces	Kilogrammes	Ounces
1917	23,542	756,891	1,306,988	42,020,579
1918	25,313	813,830	1,944,542	62,518,386
1919	23,586	758,306	2,049,898	65,905,655
1920	22,864	735,093	2,068,938	66,517,804

Since the end of last year the fall in the price of silver has checked the production of that metal, but a steady improvement in the mining of gold is still a favorable factor.

GERMANY'S terms of reparation, namely, those she appears reconciled to accept, are not easy to understand in detail. For example, it is supposed that the 25% export tax is a direct levy on the exporters; it is not; on the contrary, the stipulation reads that "the equivalent of the 25% levy shall be paid in German currency by the German government to the exporter". In short, the export tax is merely a measure of Germany's ability to pay; the proceeds of the tax are to be used in

paying interest on the bonds into which the reparations are to be funded. This is an important detail, especially if, as seems likely, any large portion of the bonds is sold to American investors.

SELF-DETERMINATION is one of the sticks of dynamite that ex-President Wilson threw into European politics, and, to speak concretely, D'Annunzio and Korfanty are two of the detonating caps that have caused particular explosions. Both are outlaws; moreover, they are pestilential nuisances in so far as they have made the European tangle the worse by their antics. Self-determination is a rank absurdity; it means a reversion to the jungle, for if all of us were to self-determine to what government we owed allegiance and to which authorities we cared to subordinate ourselves, the whole elaborate edifice of civilization, constructed in pain and travail during centuries, would disintegrate and tumble into a bolshevist abyss.

THE War Minerals Relief Commission has been reduced to a skeleton organization by the resignation of Messrs. Philip N. Moore and John F. Shafroth. They retired on May 20, leaving the third member, Mr. Horace G. Pomeroy, with the chief engineer to the Commission, Mr. J. H. Means, to dispose of the remaining appealed cases. Senator Shortridge of California has introduced a bill providing "for more liberal interpretation" of the War Minerals Relief Act. It remains to acknowledge the public service rendered by the two senior members of the Commission, particularly by the chairman, Mr. Moore. We have not agreed with his attitude toward some of those asking for relief and we think that his imputation of selfish motives to many of those who answered the national call to produce war minerals was mistaken, but we have never doubted that his own motives were honorable and sincere, and that he meant to do his duty in the unpleasant task allotted to him as head of the Commission.

EMPLOYERS of labor do not always realize that the wage factor depends, not so much on what a man receives, as on what he can buy with his earnings. Early in 1920 the employees of the Judge Mining & Smelting Company made informal complaint to the management in the matter of the high local cost of the necessities of life. As a result, the company, acting in conjunction

with its allied corporations started a fully equipped store in Park City, at which merchandise was sold to all employees and strictly on a cost basis. The annual report states that the men have been quick to take advantage of the innovation, the time and effort expended in putting the store on a working and self-supporting basis has been fully repaid by the benefits that have accrued. As a method of dealing with local profiteers, the idea might be adopted more widely.

SOME oil may still be squeezed out of Mexico's sandstone, in spite of the fact that many of the largest wells have 'gone to salt'. At least the predictions of the alarmists who profess to see the immediate exhaustion of the Mexican oilfields would seem to be a trifle premature in view of recent developments. Fifteen new wells, with an initial capacity of 650,000 barrels per day, have been 'brought in' during the last two months. The pessimist interprets this large new production as an indication of the rapid draining of the known fields; others contend that the peculiar geologic conditions of the Mexican oilfields make this inference unreasonable. One thing is inevitable: the fate of all oil-wells is to become saline, and those in the Tampico fields and in the other districts in Mexico will not prove to be exceptions. It seems obvious that what is required is to prospect and develop new territory. More intensive search would doubtless have been made already had not the insecurity of property frightened foreign capital. A definite and reasonable policy adopted by an established government would reassure those willing to finance exploration for, and exploitation of, new oilfields. The oil resources of Mexico are not even approaching exhaustion.

SILVER mined in Colorado and minted at Denver brings the producer less than the same silver minted at Philadelphia. This seems paradoxical; yet it is true, much to the chagrin of the politicians in Colorado who used their influence to have the Director of the U. S. Mint order the delivery at Denver of silver purchased under the Pittman Act. Their motive was the selfish one of assisting local industry; they never dreamed of the outcome of their activities. The reason is simple. The American Smelting & Refining Company smelts Coloradoan ores at Pueblo and at Leadville, but the semi-finished products, namely, pig-lead and matte, are refined at Perth Amboy, in New Jersey. It costs more to market at Denver the refined silver that comes from the Perth Amboy plant than to market it at Philadelphia, where it has been sold heretofore. The insurance, the expressage, and the interest charges increase, and the Guggenheims are most unlikely to hesitate to pass this additional cost back to the producer in the form of a deduction in his settlement for ores that he sells. This deduction has been fixed arbitrarily at three-fourths of a cent per ounce; the miners protest that it is too much, but objection gets them nowhere when there is no other purchaser for their ores. If it be possible for the politicians to profit by experience, they may take to heart the trite adage and next time 'look before they leap'.

The Institute Magazine

The discussion of the merits of the monthly magazine issued by the American Institute of Mining & Metallurgical Engineers, and the more recent suggestion by the San Francisco Section that it be discontinued, invites an appraisal of this particular publication and of others like it, as, for example, the magazine published by the American Society of Mechanical Engineers. These publications have grown out of the periodic bulletins issued by the secretaries of the engineering societies; at first they contained lists of new members, obituaries, and notices of future meetings, together with brief descriptions of past conventions; they were modest in size, taking the form of a thin pamphlet; they were sparing of expense, until the idea of using them as a means for obtaining income by aid of advertising led to an expansion in their scope and an enlargement of their volume into a monthly magazine. This contains the information previously distributed in the bulletins, plus a generous measure of piffle and padding, pictures and propaganda. Abstracts of technical papers are included, as well as an index, no better and no worse than the majority of such ineffectual attempts to issue a catalogue of current technical literature.

At the present time, owing to the character of its contents, the Institute magazine is not a serious business competitor of the technical press; that is to say, it does not attract sufficient advertising to hurt the legitimate press, and therefore we, for example, can view the subject with some measure of detachment and lay stress on the principle, rather than the property, involved. It must be clear, however, even to the casual observer, that if a man like Dr. Raymond were Secretary of the Institute, he could produce a publication that would cut into the advertising appropriations set aside by wide-awake manufacturers for the purchase of publicity in the technical press. In short, this exuberance of publishing activity on the part of the engineering societies may become a menace to the technical papers, and eventually threaten their very existence. Such a sequel conceivably might be regarded with equanimity by the engineering profession if the society publications could perform the service and fulfill the purpose of the technical press, or if the latter merited extinction. As to that, anybody taking the trouble to compare the current issues of the two mining papers, the one in New York and the one in San Francisco, with their back numbers, say, of twenty years ago, will find that in nothing relating to mining has there been more evident improvement than in the periodic literature devoted to the industry. On the other hand, if a comparison be made between the Transactions of the Institute today and the Transactions of twenty years ago, it will be found, we believe, that the gain is more of quantity than of quality. In 1901 the Transactions were edited with a loving care and an unflagging zeal that gave them a uniform excellence such as belongs to no other body of diverse technical writings. The quality could not have been so high if the quantity had not been kept within reasonable limits. We submit that

the editors and publishers of the two mining papers have performed their duty to the profession sufficiently well to be entitled to friendly consideration. Their business exists on a purely competitive basis and they ask only the favor of fair play. This they are not getting. The Institute magazine may be set down nominally at \$5 per annum, out of the \$15 paid as regular dues from members, but it would not have a thousand subscribers on its merits even at half that price; it goes to the members of the Institute because they have no choice in the matter; its publishers claim that it has 10,000 subscribers because it is mailed to that number of persons; and thereby they can make a misleading comparison with the subscription lists of the two mining papers. The comparison is misleading because the major proportion of the copies of the Institute magazine goes promptly to the wastepaper basket, but it is used as a plea for the purpose of obtaining advertising. In addition, the putative advertiser is asked to be impressed by the fact that the magazine is the official organ of the Institute and that any support given to it by the manufacturer will be appreciated by the influential gentlemen on the board of directors.

The only claim the legitimate technical press makes is that it is read, as well as received, by the persons to whom the advertiser desires to present his product; the directors of the technical press are not engaged in mining and they are not connected with smelting operations; they are publishers only. The editors and managers of the 'Mining and Scientific Press' are engineers, but they do not practise their former profession. *No sutor supra crepidam*. The whole procedure of Institute journalism may be compared to the starting of a local grocery by the Y. M. C. A., using its humanitarian affiliations as a means for creating a clientele; it is as if the U. S. Golf Association should establish a store for the sale of sporting goods. A closer analogy perhaps will be found in the activities of the National Geographic Society, one of whose circulars came into our hands this week. This circular apprized a neighbor that he had been "nominated for membership" by Mr. A. B. Blank, whom he did not know, and that his membership would make him "one of a group of persons of distinguished educational, industrial, and scientific service". All he had to do was to forward the annual fee of \$3.50, which would entitle him not only to the "fascinating articles in the Geographic Magazine" and to association with the truly great, but it would also give him "the right to nominate" his friends for membership in the Society! Was ever commercialism more ludicrously camouflaged? Again, we are reminded of a Mr. R. Stuart Browne, who about twelve years ago ran a paper in San Francisco called the 'Pacific Miner'. He needed subscribers, so he founded a society for the ostensible purpose of ministering to the greater glory of the profession, and devised the plan of giving membership in his society to every person subscribing for his paper. Besides this he authorized them to use a luminous tail of initials; if we remember correctly the suffix was M. A. I. M. & M., apparently in intelligent anticipation of the gentlemen in New York!

Joking apart, we submit that the Institute is spending energy and money on a publication that is not needed; its notices of meetings, lists of candidates, index, and other odds and ends could be distributed as formerly, in the shape of an inexpensive and non-competitive pamphlet. The interests of the profession are not all in the care of the Institute, excellent as may be the work it is doing; the technical press can claim fairly to have stood for those interests in the past and it shows no signs of apostasy in the present. The profession needs an independent journalism just as much as a central organization. Each has its function to perform, and each should be given a full opportunity to perform it. The technical press has progressed and is progressive; it is doing its share of good work; we submit that it is entitled to fair play. We appeal to the profession, and more particularly to the titular leader of our profession, Mr. Edwin Ludlow, the president of the Institute.

An All-round Engineer

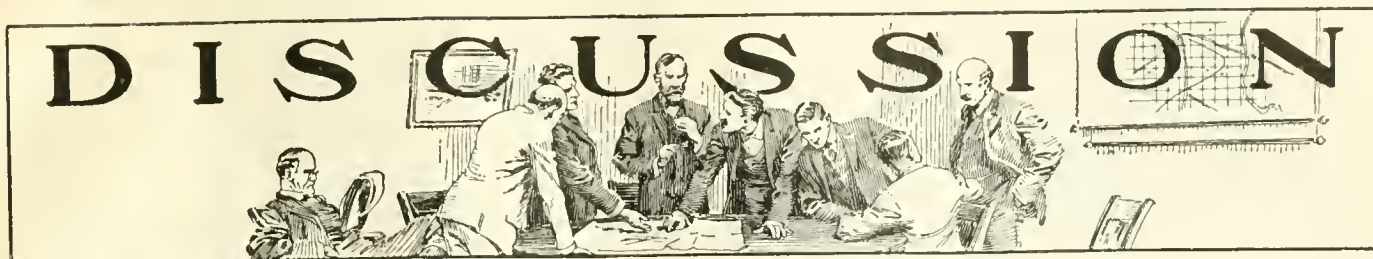
At the last meeting of the American Mining Congress, at Denver, in November, a certificate of honorary life-membership was handed to Mr. David W. Brunton, and the incident evoked hearty applause. It served not only as an appreciation of his services as a director of that organization of mining men, but it marked the high esteem in which he is held in the mining fraternity. Shortly afterward we took an opportunity to interview him, as appears elsewhere in this issue. Mr. Brunton belongs to a group of Canadian-born Americans who have played a conspicuously useful part in our national mining industry. To that group belong Richard P. Rothwell and James Douglas among the honored dead; to it belong E. P. Mathewson and W. J. Hamilton among the honored living. Our young men, curious to ascertain the steps by which their seniors achieved success, will note that Mr. Brunton was fortunate, first, in coming of engineering stock and, second, in being educated at the University of Michigan. A touch of romance, that is, of the delightfully fortuitous, was given to Mr. Brunton's start in life by the visit of a gentleman from Colorado to the university at Ann Arbor. This stranger from the Rocky Mountains was the president of a mining company in search of a young engineer to take charge of a small property in the picturesque San Juan region. This first call to the mines proved abortive in its economic results, but it led to a new engagement, and to a critical event in Mr. Brunton's life, namely, an acquaintance with James Douglas. To know men is more than to know mines; the friendship that developed with Douglas was one of the good things of life. And many are the men who have been able to say that about James Douglas! It seems like the turning of old pages to read about the Hunt & Douglas process at Georgetown and then to find a mention of Joshua E. Clayton. Those early experiences in Colorado and Nevada did not seem to lead anywhere in particular but they gave the young Brunton of those days a variety of experience, developing his character and opening his scientific eyes to the basic principles of the

mining industry, so that he was ready for the big opportunity when it came, in 1879, at Leadville. There he became associated with his life-long partner, Mr. Frank M. Taylor, together they built the first concentrating mill at Leadville, and, later, erected and controlled several sampling mills at Aspen, Salt Lake City, and Cripple Creek. This phase of ore-dressing became a specialty to Mr. Brunton; it proved highly profitable to him, and it gave him an opportunity for the exercise of his ingenuity in mechanics, for he invented a contrivance that has become standardized in the sampling of ores. Here we may refer to the other device that carries his name, the compass familiar to mining engineers. During the War this Brunton compass proved valuable in artillery practice, many hundreds having been used advantageously on the battlefields of France.

As has been suggested, the Leadville adventure proved a decisive event in Mr. Brunton's early career. It gave him an opportunity to study the concentrating and sampling of complex ores; moreover, it gave him a chance to examine the ore deposits of a district marked by a remarkable intricacy of geologic structure, and to appreciate the structural relations of orebodies, particularly with regard to faulting and brecciation. In due course he was asked to participate in the flood of litigation that almost submerged the mining industry of Aspen; he became an 'expert' in a series of important apex suits, that is, he was a witness in court. But he did more than that, he directed the work underground that served to uncover the evidence needed by the lawyers. This, of course, gave him an unusual opportunity for becoming familiar with the local geology and of developing his own general knowledge of economic geology. He still continued his engineering work and supervised the driving of the Cowenhoven adit and the sinking of several deep shafts. His reputation at Aspen led to his being called to Butte, where apex litigation on an even bigger scale had been started. There he devised new systems of mine-mapping, and, as consulting engineer to the Anaconda company, planned the exploratory work underground that resulted in the uncovering of large masses of ore. We asked Mr. Brunton, it will be noted, what he thinks of the present system of bringing evidence into court; he states, as we thought he would, that unbiased testimony is difficult to obtain from witnesses engaged by the litigants themselves and therefore already committed to one side in the dispute. As an example of a better method, he quotes an experience of his own in a Canadian court. In later years Mr. Brunton has lived in Denver, partly on account of his interests in the neighboring mining districts, notably, Cripple Creek, where he served as the engineer in charge of the Roosevelt adit, in the driving of which a pneumatic water-fed hammer-drill, invented by the late George Leyner, a Denver man, first came into prominence. From Denver Mr. Brunton has been called in an advisory capacity to distant places, among them Spain, whither he went in 1903 to advise the Rio Tinto management in regard to the recovery of ore left in their old workings. He has traveled all over the

world, and around it. During the War, of course, he did his share of patriotic work, and it proved to be important. As a member of the Naval Consulting Board he tells us, as others have done, that if the War had lasted a little longer the world would have been astounded at the deadly inventions and lethal devices that would have been brought into action. Another general war is unthinkable for that reason, if for no better one.

The mere record of a man's achievements does not tell the story of his career, for a man can do many things worthy of being chronicled and yet leave no enduring footprints. The best memorial is the one that is transmitted by the living. In the first place, Mr. Brunton has been accepted as a leader among men, having been president of the American Institute of Mining Engineers in 1909-1910. To this mark of distinction we venture to add the statement that in accomplishment and reputation he stands second to no mining engineer in the English-speaking world. He is one of the few mining engineers that have kept away from speculation, promotion, and the other dangerous, if not shady, sides of the mining business; he has preferred to stick to engineering work, rather than make money quickly in devious ways; for that reason his standing is unquestioned and for the same reason he has enjoyed a mental poise highly conducive to real scientific work. He has the ability to concentrate his mental faculties on the problem in hand. By the same token he prefers a few friends rather than common popularity; he sticks to a friend and does not forget an enemy; he is a man of positive character, not a Laodicean. He is a man of progressive and independent ideas; he was one of the first to drive an automobile in Colorado; he has experimented with a score of them since, and was nearly killed in a motor-accident eleven years ago. A friend who has motored thousands of miles with Mr. Brunton says that he is impatient of stupidities or dishonesties of any kind, but is generous to a fault. Like all true students, he is avid for information. On board ship, having seen a friend in conversation with a newly made acquaintance he asked, "Does he know anything?" He remembers his fellow-workers even after many years. When in a club at Waihi, New Zealand, he heard the name of Stansfield mentioned as the manager of the Talisman mine. He recalled the fact that Mr. H. Stansfield had worked for him or with him in Nevada twenty years earlier and promptly got in touch with him by telephone, this resulting in a visit to the Talisman. One of his oldest friends, who has voyaged afar with him, summarizes his impressions thus: "He is a man of particularly strong likes and dislikes; absolutely true to his convictions; loyal to a degree in his friendships; of exceptional determination in his undertakings and possessed of a deep insight into human nature as well as things material." We confirm that, and to it we add that he is blessed with a sense of humor that lightens the dark places and a geniality that thaws the frozen currents of life. Yes, a man every inch of him, an excellent engineer, and a good citizen. The mining profession is proud of him.



Standardization of Mining and Milling Materials

The Editor:

Sir—I was interested in the article on this subject by E. A. Wraight, in your issue of March 12, particularly that portion referring to stamp-battery parts. I think the article gives the impression that the mill operators have taken what the manufacturers have offered in the way of mill-parts with but little effort toward finding out and demanding the material best suited to the purpose. Probably the mill-men have been more at fault in failing to co-operate, each one carrying out his own experiments and investigations without letting others know of the results.

In the article manganese-steel is suggested as a suitable material for shoes. Several attempts have been made to make shoes of manganese-steel, none of them successful. I believe there is difficulty in making manganese-steel castings more than three inches thick. Two sets of five manganese-steel shoes tried in the North Star mill failed because a flat disc the full diameter of the shoe and from 1 to 3 inches thick broke off periodically. Apparently the wearing quality was good apart from this loss by breakage.

At the North Star mine when two 40-stamp mills with 1050-lb. stamps were being operated at 110 drops per minute, the 6-in. diam. 10-stamp cam-shafts, with which the mills were equipped, broke very frequently. One 40-stamp mill broke 11 in one year. The average life was about one year. Shafts made of chrome-nickel steel, vanadium-steel, mild or machinery steel, 'Flyer iron', and forged wrought-iron were tried in an effort to minimize this breakage, and the forged wrought-iron proved to be by far the best material. The fact that nine-tenths of them break under the second or third cam from the free end of the shaft indicates that the factor of safety has but little to do with breakage. The vibration snaps about 5 feet off of a 16-ft. shaft.

It is stated that fractures of stamp-stems are unusual and due to impact, and that stresses are in the direction of the grain. My experience is that fractures are not unusual, and are due to bending where the stem leaves the boss, when the weight of the falling stem lands on one side of the shoe. Practically all breaks occur within a few inches of the top of the boss.

I prefer thin punched steel for battery-screens, not on account of long life, but for freedom from clogging. The cost of the screen is a small item when crushing capacity is involved.

It is stated that a cast-steel battery-frame was erected at the Tightner mine. This is not correct, the frames are of cast-iron, the posts cast in one piece, with cast-iron guide-girts bolted to them; the girts being bored for the base half of the stem-guides, with the guide-caps bolted to the girts. When the two 40-stamp mills at the North Star mine, mentioned previously, were consolidated into one 60-stamp mill with 1500-lb. stamps, cast-iron battery-posts were installed. These were cast in two pieces to make erection easier. Eight-inch H-beams are used for guide-girts, with cast-steel stem-guides bolted to these. When cast-iron is used for battery-posts, there must be enough weight in them to eliminate excessive vibration by virtue of their inertia. Furthermore, it has been found that these solid heavy posts absorb or dampen a large proportion of the vibration in the cam-shafts, practically eliminating breakage.

ARTHUR B. FOOTE.

Grass Valley, California, May 10.

Prospecting

The Editor:

Sir—Upon invitation of a recent editorial in the 'Mining and Scientific Press' I venture to give my ideas upon the future of prospecting. I am a prospector—also a student; in another year I shall be a graduate from one of the mining schools of the North-West—but I shall still be a prospector. When "school" is mentioned the reader doubtless instantly pictures a youth of ordinary college age. But no, my college life has been very intermittent. Two years of war has placed my first and second years of mining engineering far apart. Four years of prospecting and mining preceded my entrance to college, and so, though I am a young man, some practical as well as theoretical experience has been my lot.

At twenty-one a trip for my health to the mountains of a sunny western State introduced me to the gold pan. Fortune led me to the outcrop of a gold-quartz vein just rich enough to keep me digging and return me to robust health. With my partner, also a young man, a few years my senior, we dugged and burrowed. Shaft and tunnel brought specimen ore again and again but never in quantity great enough to assure our fortunes. We tried milling our best with an arrastra run by steam power but the best result was just wages. A mill not adapted to our needs proved a failure. We suspended operations. I came to college to learn of that in which I was interested. My partner prospected elsewhere.

The War came and we both enlisted in the same com-

pany. I returned but he did not. He married a French girl. Upon my return to the States I resumed college work with still the determination to acquire the technical knowledge that would better fit me to be a prospector. "The first step toward knowledge is to be conscious that one is ignorant." The old-time prospector of the hills does not realize his limitations. The successful prospector of the future must realize his. Difficulties not encountered by the old must be met and overcome by the new.

At this the close of my third college year I have leased my mining claims to a company that has agreed to perform extensive development work upon them. To me has been assigned the task of directing this development. I must erect bunk-houses, expose surface croppings of veins, sink shafts, and drive adits. As I know the history of all our prospecting work and know where the best ore occurred it is to be my duty to search for the richest ore-shoots. The summer is before me; if success be mine it will be well; if nature has deposited her precious metals in abundance elsewhere, still it will be well; I shall return to college, finish my course, and return to prospecting better equipped than before.

There is a future for the prospector, but not for the old-time type, especially if he insist on spending most of his time in his cabin dwelling on reminiscences and stories of bonanzas. Placers are fast becoming fewer, veins and lodes are yet to be found. Alaska, in this last respect, is almost untouched; the resources of British Columbia and those of other parts of Canada are open to the American prospector as well as the subject of the King. Fields and opportunities are many but prospecting has yet to be recognized as a profession, worthy of the consideration of a college-trained man.

A college education will not make a prospector, but it will aid substantially in starting one upon intelligent exploration. It is noticeable that few men graduated from mining engineering do any prospecting. One may become an assayer, one a surveyor, another a mine superintendent, and, as frequently occurs, some do not follow mining at all. Prospecting is left to the old-time sourdough and he is fast disappearing.

Prospecting, as systematic search, has, I believe, a future—a big future—but for individual success in following it there appear these inevitable requirements: knowledge of the elements of geology and mineralogy, keen powers of observation, faith in nature, physical endurance, and intense interest and love for the prospecting profession.

WADE V. LEWIS.

Corvallis, Oregon, May 9.

The Editor:

Sir—Regarding the article on this subject appearing in your issue of April 23, I wish to call your attention to one reason why no new mines are being discovered.

I have been out in the mountains much of the time for the past two months, and I find that almost every outcrop has a notice of location on it, many of these locations

dating back to 1916. To my own personal knowledge many of these locators have left this district and have abandoned these claims and do not want them, yet their title will be perpetuated by a bill recently introduced in Congress by Senator Bursum of New Mexico thereby closing these claims to entry by prospectors who would dig and might find something.

Prospectors and miners and mining engineers do not want this measure passed, I feel sure, but they are not the only ones affected. The advertisers in your pages are vitally affected by this class of legislation and many others. The trouble is that so few people realize just how it is actually working in practice.

Luning, Nevada, May 9.

FRANCIS O'BOYLE.

The Editor:

Sir—You give an invitation to chip in; I will take one stack. We all know that the discovery of payable mineral is on the wane. A long experience in prospecting makes me believe that this is due to the conditions the country is in at the present time. There is not a State here in the West that has not been gone over by the prospector; a number of these with easy showings, with outcrops or float gold, have been found. All the mineral areas in the mountains are dotted with prospect-holes, most of which show but little; but they are a great help to the prospector; if they were not there he might be wasting his time; in most cases there was some good reason why these holes were put down, such as the finding of float, good pinnings, outcrops, or a favorable looking formation. Such holes are a great help to future prospecting. During the past few years minerals containing tungsten, vanadium, uranium, tin, and numerous others, have come to the front; anyone that follows the business of prospecting ought to turn his attention to these. Most of us know about gold, silver, copper, lead, and the more common minerals. The numerous bodies and veins of iron ore are apt to contain some of these less common minerals. I believe that prospecting in the United States at the present time is brighter than it has been in the past; we have spent too much of our time on little indications—small streaks and the like—where one could only hope to make a small stake. Now most of us are looking for something larger, perhaps for hidden overlooked bodies of the rarer minerals that are being brought to our notice every few months. Some of the old dumps that were made when working for the common minerals are found to contain other valuable mineral nowadays. But we who are making our living with the pick, pan, and lead-pencil are mites compared to the oil-drillers who bring in the new fields. There are thousands of these men who have been drilling for oil for years; the best the majority of them get is a 'duster'—a dry hole. They are the greatest prospectors the world has ever seen. Wild-cat drillers are the ones to take a chance—dreamers and pioneers—maybe a life-time spent with a Keystone or Star rig, rustling money to get their holes down two or three thou-

sand feet; then, one big shot with two hundred quarts of nitro-glycerine, a big puff of white spray, an awful roar, then all quiet. They move to some new field. All of us are playing for a thousand-to-one shot. I have made lots of hundred-to-one shots; I have put in most of my time rustling with the pick and pan (I am no spring chicken), but whenever I find myself with a few dollars I dabble in oil or a duster, just a piker as yet. Many a big deposit of valuable ore has been overlooked in these deep drill-holes; all the analysis that is made of the sludge that is brought up by the bailer is for oil. We hear the cry all around that the country has been prospected to death, but it is not so; the ore is only harder to find. It keeps one rustling to keep going. We need help, but we don't get it; as a rule we are able to work out our own salvation. It is not easy, but it is not hard, as there is always a way to make a rifle. The only help the Government has ever given us has been to ease up on our assessment work; but they wait till the last minute on that, and then there are a lot of kickers. Some that don't know enough or are too lazy to find a prospect, want to locate something that some poor devil of a prospector is trying to hold. The great trouble is we don't last long enough to take everything in. We all have our ups and downs; most of us have had some bad experience—out in bad weather with nothing to eat for weeks at a time except what we could catch—but we always caught it. Then we had our coal-oil-Johnnie days. As a rule we don't worry over our past hardships; but we do think with a thrill of joy of the other days. If I had my life to live over again I believe that I would prospect just the same. The one great fault most of us are guilty of is staying, as they say of the oil prospector, with a dry hole.

FRANK P. DAVIS.

Fluorine, New Mexico, May 2.

'Science and Life'

The Editor:

Sir—In a review of Professor Soddy's 'Science and Life', Mr. A. W. Allen undertakes, I think, to strike at religion over the Professor's shoulder, though, at the same time, despite the latter's profound knowledge, he thinks him "turgid". Is it not quite possible that the author has entered a new field, the more so that his life has been given to the study of a specialty? A broad and just view of the spiritual life takes a long time to acquire, and it is entirely possible that the notions on religion set forth in the Professor's book are crude and unfinished like his attempts at writing. I know from various experiences that, as a listener to sermons, when the preacher undertakes to use scientific illustrations, he generally makes a mess of it, and so the author's endeavor to express himself in the spiritual field has no better fate. We admire his profundity in his own line and greatly respect all he says in it, but, as I have also noted in Thomas Edison's attempts along the same line, undigested vagaries may be presented—views due to narrow vision.

So many, in writing on these subjects, fancy it rather grand to have a bit at the "creeds", who, were they asked what they mean by "creed" would have in mind *any* wind of doctrine. I can assure Mr. Allen that a generation ago when Darwin's views on evolution were pressed to the limit, scientific men were cocksure they were right. Today, many of the older notions, like imperishability of matter, conservation of energy, the imponderable elastic interspatial ether, the transmission of acquired characteristics, are no longer looked upon as finalities.

Science has by no means banished the idea of God's control of the universe, and in the orthodox Christian creed is to be found faith, love, and inspiration. That master-mind of philosophy, Henri Bergson, truly says:

"Many people are hard, narrow and unhappy, and are living without faith, hope and peace, which should be every man's possession, because their minds are imprisoned in a little, narrow, rigid mechanical philosophy, into which they are trying to compress life."

Another assertion, that the idealist is "blind and deaf to science", I take to be an unworthy exaggeration, when we know how the applications of science are known to intelligent men. Certainly, idealists, of all men, should least fear annihilation, nor can one see that they care for science only because of its usefulness in war.

Of course, there are lots of engineers, whose scientific training has left them skeptical, but there are plenty of us who would resent the imputation that we can only talk 'shop'.

L. S. AUSTIN.

Los Angeles, May 8.

The Editor:

Sir—Professor Austin's letter calls for a reply. I do not think, nor did I state, that Professor Soddy is "turgid"; the idea that I quoted extensively from his book for no other reason than "to strike at religion over the Professor's shoulder" is, of course, absurd. The fact has apparently been overlooked that the contribution under discussion was a book review. I, personally, am not the logical target for the Professor's assurance of disbelief in Soddy's views.

The above letter is interesting as illustrating the diversity of opinion that exists on the matter of reviewing. A recent correspondent, who gratuitously referred to the faults of another book under review, objected to adverse comment or correction being made by the reviewer; Professor Austin now objects to the quotation of pertinent matter, seeing in such a method an insidious attempt to strike at something or somebody over the shoulder of the author. So what is the poor reviewer to do?

San Francisco, May 12.

A. W. ALLEN.

Chief Consolidated Shaft

The Editor:

Sir—I beg to inquire if it would be possible for you to publish the following correction to Mr. Arthur B. Parsons' article, appearing in your April 30, 1921, issue,

on sinking No. 2 shaft of the Chief Consolidated Mining Company, Eureka, Utah:

In fairness to the manufacturers of the following drill machines, the contractor, Walter Fitch, Jr., Company, wishes to state that three types of jackhammers were used in sinking this shaft: The Ingersoll-Rand 'Butterfly'; Sullivan Machinery Co. 'DP-33'; and the Denver Rock Drill 'Wagh Clipper', all of which gave equally good service and satisfaction.

Any favor you can extend in this matter will be appreciated.

WALTER FITCH, JR., COMPANY.

Eureka, Utah, May 13.

Prospecting

The Editor:

Sir—In your issue of April 23, 1921, the article on 'Prospecting, Past and Future' is extremely interesting, particularly to those who have been engaged in prospecting, or closely associated with those directly engaged in this particular branch of the mining industry.

While you describe most of the methods employed, there is one in particular that you have not mentioned, the nearest approach to it being your description of 'costeaning'. The method to which I refer has been responsible for numerous 'strikes' or discoveries of gold-bearing veins and orebodies throughout the Western States.

This method was first developed in the course of pocket-mining in the foothill counties of this State, notably Tuolumne, Calaveras, and Amador. It has been called "panning to locate pockets". Many of your readers, no doubt, are entirely familiar with the method, possibly some are not, and as it is an extremely useful one for the discovery of pockets, bunches, or larger orebodies of gold ore, it may be of assistance to some of them.

Briefly the method is as follows:

Having selected an area on a side-hill that appears likely to contain goldbearing veins, even though they are blind, that is, do not outcrop, the prospector starts near the bottom of the hill, and commences panning (or washing) the loose dirt in the slide, or debris, for gold. If he finds no colors at first, he continues along the general line of a contour of the hill, panning the dirt at every 10 or 20 ft. until he finds colors. At this point he sets up a stake and continues his progress along the line of the contour, panning carefully at intervals of, say, 10 ft., and continues this procedure until he is unable to obtain any further colors when washing the dirt. He then sets up a stake at the last spot at which he was able to obtain colors; he then checks back over the line he has been following to the first stake, to be certain of his results; having assured himself in this particular, he goes up the hillside a matter of 10 or 20 ft., and starts the same procedure, setting up stakes where his colors commence and end. Continuing this method he soon has two rows of stakes, marking lines that converge up the hill, and that will converge sharply, if it is a pocket, or bunch, in the vein; or if they do not converge sharply, and are more

nearly parallel, indicate a more disseminated condition of the gold.

This work is continued up the hill until the panning of the dirt shows no color, which indicates that he is above the vein, and having checked this conclusion by panning inside the area indicated by his stakes, he obtains a line below which the dirt shows color, and above which no colors show, which line indicates the probable course of the vein, and the length of the orebody near the surface.

At this point the usual course is to sink, to find the vein if it is covered, or run a cut for the same purpose. In the case of pockets, or bunches, the pannings will usually show more gold at some point in the line, indicating proximity to the vein, and the remains of the pocket in same, or if the gold is disseminated in the vein, and not concentrated (as in a pocket), the development work can proceed in the manner best suited to local conditions.

If the vein has an outcrop, the matter is simplified, for panning the dirt below the outcrop will show colors of gold, if the vein itself has any gold in it, and the orebodies can be found in this way.

This method has been employed by me in quite a number of instances. The orebodies in the Pamlico mine, near Hawthorne, Nevada, were discovered in this way. Rich float had been found, and although the vein outcropped, the miners were unable to determine where it came from, until I used this method. Fortunately, the dirt below where this vein threw gold from a pocket, or bunch, carried very good values, in fact, from this particular 'fan' we screened (inch openings), and sacked about 100 tons of dirt, which was sent to the mill, and yielded at the rate of about \$110 per ton.

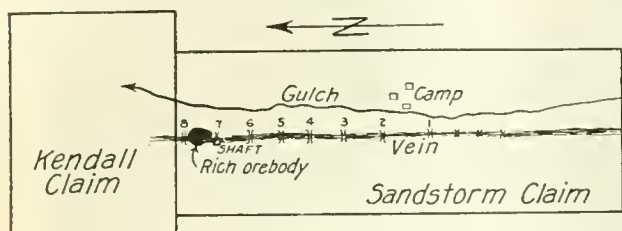
Working upward on this brought us to the vein, which was blind, and which contained the remainder of the pocket, about \$1000. Sinking on this vein showed it to be distinctively a pocket-vein, as the ore occurred in bunches 8 or 10 ft. apart, which bunches might have \$500 or \$15,000 in them. One man took \$15,000 (all in three sacks) on one shift from one of these bunches; some of this ore went \$100 per pound; between the bunches the vein (12 to 24 inches wide) consisted of barren white quartz.

An instance where a failure to use this method lost a fine orebody occurred in the early days of the Goldfield district, at what is known as the Sandstorm mine. This property I had taken under bond for a company operating at Tonopah (the Ohio Tonopah Co.), for which I was in charge.

Having secured the property, I took out a few men and made a camp. We ran some cuts across the big north and south vein that showed on the property. From some of these cuts I obtained good assays, but most of them were low, so I concluded to try the panning method, and to that end took out with me from Tonopah an outfit of screens, pans, a tub for washing, etc., and instructed the foreman to commence the following morning, panning along the side-hill just below the vein to determine

where the gold (if any) occurred. Upon my return to Tonopah that day I found a gentleman there, sent out by my company to take charge of the Goldfield work, as I had quite a crew working in our property at Tonopah, so I explained the situation to him fully, and he went out that evening, and took charge; he immediately discarded the panning method, and started cuts across the vein 50 ft. apart, and carefully sampled the cuts.

This rough diagram shows the situation.



The vein in these cuts showed only small value, except in cut No. 7, from which an assay of about \$60 in gold was obtained. The party started an incline-shaft at this point, but as the material did not hold up in value on sinking (about 10 ft.) he abandoned the work, and transferred the crew to the Atlanta ground, which I also had under option for our company, which then abandoned the Sandstorm.

Later, prospectors came along, and, by panning the surface, found that between cuts No. 7 and No. 8 there was a considerable body of extremely good ore. I understood that they took out about \$150,000 in ore running close to \$200 per ton.

If the panning method had been employed we would have located this orebody with a very small expenditure of time and labor. Other instances might be mentioned, but these convey the idea.

The prospector is a necessity in all mining districts, and is as much a part of the mining business as the miner, the machine-man, the mucker, the foreman, or superintendent; he is the advance-agent blazing the trail, and showing the others where they can work to advantage. To succeed he must be observant, careful in his work, and use a lot of common sense.

The mineral areas have only been scratched; there will be prospecting and mining all through these Western States a thousand years from now, and the optimistic prospector will be in demand then as at present to find new deposits for others to develop and exploit.

More luck to the prospector wherever he is.

San Francisco, May 3.

S. A. KNAPP.

The Editor:

Sir—In your address on 'Prospecting' you touched upon the fact that this calling is not followed to the extent it formerly was. You gave a number of reasons for this. I would like to mention one reason not given by you that while not as broad and far-reaching as those you mentioned does exert a powerful present influence.

It is a fact that since 1917 no claims have lapsed because of legislation excusing the performance of annual

assessment work. In this four years the 'peggers' have been busily at work until practically all parts of the public domain which have the remotest possible mineral value are located.

Up to 1917 probably nearly as many claims lapsed each year as were located. Not but what some claims have been patented each year and many held by annual work, but, speaking generally, the amount of ground open to location and hence attractive to a prospector remained about the same. But since 1917 no valid location, made and completed, has lapsed. There has also accumulated each year a great number of new locations. The result is that the public domain which interests a prospector has become extremely limited. He is not going out into the hills for the very simple reason that he does not care to prospect some one else's ground. You would not if you were in his place. The incentive that if he finds something good it will belong to him is gone, or very largely gone. This condition will continue until there is a clearing time.

It had just about become a settled thing that July 1, 1921, is to be the clearing time. This was the last day for the claim speculators to hold their ground without work. Now some ass in the Senate introduces a bill under the terms of which annual assessment work will be excused for 1921 and 1922. This opens up the subject all fresh. It introduces a new element of uncertainty.

If you can see your way to do so, it seems to me that you could give prospecting a great help by devoting one of your clear editorials to an analysis of the effects of this law and point out that the time has come for it to end. It helps no one but speculators and slackers. I believe that this is the universal opinion of the bona-fide mining people.

E. C. WATSON.

Luning, Nevada, May 9.

[We have written in this sense several times; for example, in our issue of May 14.—EDITOR.]

American Trona Corporation

The Editor:

Sir—Some years ago my partner and I acquired a considerable block of stock in the American Trona Corporation, believing that we had secured a good investment. This belief was grounded largely on the fact that the control of the company lay with the Consolidated Gold Fields of South Africa, Ltd., which we thought would ensure the best management. At that time—1917—the War had stopped importations of potash, and prices on potash, borax, soda-ash, and sodium sulphate, all recoverable from the brine of Searles Lake, were soaring. The company had an unlimited supply of raw material; its railroad to the property was in operation; the necessities of the Government made the production of the various salts a favored industry and we understood that the money was not wanting for development. All the conditions seemed perfect for great money-making.

Yet, month after month production remained small and the management was so dilatory that never during

the War or since has it grown to anything like what was promised. A 'refinery' was built at San Pedro but never operated, and it finally developed that it was built on leased land and was abandoned before being used, a fact that was, so far as I know, never told to the shareholders and only appeared when an enormous charge appeared in the balance-sheet for "Loss on San Pedro Plant, \$403,421.79", along with "Amortization Allowance on Capital Expenditures During the War Period, \$250,000".

The report issued to the shareholders under date of October 31, 1919, ten months after the close of the fiscal year, showed that a gross profit before depreciation, amortization, and obsolescence of about \$1,700,000 was made in 1918. The company was carrying loans of \$1,200,000. The shareholders were informed that a new management was in charge and that greater output was coming.

The report of November 15, 1920, showing results under the 'new management', showed that the output of potash salts had fallen from 21,319 tons in 1918 to 13,296 tons in 1919; that a gross profit of about \$1,700,000 had been turned into an operating loss of \$234,631, and a net loss of \$719,524; and that the loans had increased to \$1,950,000. The report gravely states that "additional improvements contemplated should result in *further increased production and reduced costs*". Yet, plant operation cost had increased from \$631,030 in 1918 to \$1,187,229 in 1919 and overhead, interest charges, etc., had increased from \$423,314 to \$426,173, or over one-third of the value of the entire output for expenses other than operating costs.

The change in management, mentioned in the report of October 31, 1919, does not appear to be much of a change according to the list of officers given in the succeeding report, and the board of directors has changed little since 1914. The real and responsible management remains in the Consolidated Gold Fields of South Africa, Ltd., and the shareholders who invested their money on the strength of its supposed good management seem to have little to hope for unless radical changes are made in the handling of the company. To pass the management through a New York office, when it could be much more economically and efficiently handled direct from Trona, seems cumbersome, expensive, and unwise. When will the Gold Fields learn to concentrate and give us some return on our investment? We still believe that a competent, centralized management should produce profits.

San Francisco, May 12.

C. G. FOWLER.

The Gold Reserve

The Editor:

Sir—In your issue of May 14 you state that gold continues to accumulate in the vaults of the Federal Reserve banks and that like Midas we have discovered that one can have too much of it in the sense of medium of exchange; that many of our legislators seem to fear the prospect of being paid in goods from overseas and appear anxious to build a Chinese wall of tariff so as to exclude

imports; that financiers and economists of the less pronounced set recognize the fact that it is to our interest not to collect more of the gold of the world but to encourage commerce with our customers in Europe.

As to the great accumulation of gold in the vaults of the Federal Reserve banks, I think if you will investigate how it is that so much gold is being sent here from all parts of Europe you will find it is money due to the United States for goods sold and some of it for money lent to some of these governments in Europe. Not very long ago the United States Treasury gave out a statement that England had paid the United States \$25,000,000, being the first payment on the loan they made at the time they were in need of silver. It is also reported that England is sending money over to the United States to be prepared to pay the interest due on their loans this year.

It seems to me the accumulation of gold in the Federal Reserve banks is no detriment to the business of the country; on the contrary, it will enable the Federal Reserve banks to lower the discount rate and thus help the general business conditions of the country. When the gold was going out of the Federal Reserve banks and the bankers were warned not to extend any credit except it was absolutely necessary, a great many bankers expressed the opinion that America ought not to make any further loans to Europe but to try to collect some of the money due us.

Europe still owes America a large sum of money and the putting on of a tariff is not done to build a Chinese wall around us, but simply to protect our own industries against the cheap labor of Europe. It seems to me that the late war ought to have been a good lesson to America that America ought to try to build up its own industries so as to be as independent, as much as possible. The more gold we have in the country the stronger we will be financially and the more assistance we may give to our own people.

The Federal Reserve Bank is a good watchdog to see to it that there will be no inflation again. In fact, I can't see how we can have any inflation while all of the European nations are trying their best to make a bid for the world's trade. It was different during the War, when the principal nations were producing but little and had to come to the United States for what they needed.

San Francisco, May 16.

HERMAN ZADIG.

ACCORDING to J. W. A. H. Smit, who contributes an article on the cupellation of gold bullion to 'Rec. Trav. Chim.', the surface and porosity of the cupel are not of such importance as its thermal conductivity. The ratio of lead to copper must be at least 55:1, and may be higher. Heating of the button after iridescence is necessary for commercial samples of gold, and in the case the best ratio of silver to gold is 2:1. The cornets should be well heated both before and after boiling with acid, and it is advisable to roll the buttons into sheets 0.15 mm. thick.



IN THE SAN JUAN REGION OF COLORADO

David W. Brunton: Consulting Engineer

An Interview, by T. A. Rickard

Mr. Brunton, you come of the old stock?

My parents came from Scotland; my father from Selkirk and my mother from Kilmanock. My mother's people are now engaged in coal and fire-clay mining, but in the stormy days of the Reformation the Howies followed the blue and scarlet flag of the Covenanters, and the old Howie homestead at Lochgoin, which has been in continuous possession of the family for 700 years, is now used as a museum and repository of Covenanter relics.

Where and when were you born?

Ayr, Ontario, Canada, in 1849.

What was your early education?

Public school, followed by grammar school, after which I went to Toronto, in 1870, and began engineering work, as was the custom then as an apprentice, under J. C. Bailey, the most prominent engineer in Canada and a member of the English Institution of Civil Engineers.

You come naturally by your engineering career, do you not?

Yes, most of my father's people have been either engineers or army men, some of them having made excellent

records in England, India, and Australia. One of my cousins, recently deceased, J. Dickinson Brunton, was an inventor of stone-dressing machinery and of the tunneling machine, with which he made the preliminary borings for the proposed tunnel under the English Channel.

When did you come to the United States?

In 1873, and in '74 and '75 I took an advanced course in geology and chemistry at the University of Michigan.

Had you any idea at that time of engaging in mining?

Yes, the studies just mentioned were undertaken because after four years experience in civil engineering I became convinced that at that time mining engineering offered a more attractive field.

Did you come directly west from the university?

Yes. The president of the Dakota & San Juan Mining Co. came to Ann Arbor in June 1875, and asked the faculty to recommend a young engineer to go with him to the company's mines in Colorado. They were kind enough to recommend me. I accepted the position and reached Denver on June 20. The company's mines were situated at Mineral Point, in Ouray county, and the near-

est railroad station was Pueblo, 230 miles distant by a recently opened trail, over which all supplies had to be packed.

Did you remain at Mineral Point throughout the winter?

No, the Dakota & San Juan Mining Co. failed to get in sufficient supplies for the winter and we were obliged to come out before the passes were closed. I was fortunate enough to obtain a position as metallurgist for the Hunt, Douglas & Stewart Co. at Georgetown. This proved the beginning of a delightful friendship with James Douglas that lasted throughout his life.

Was the process applied successfully at Georgetown?

It was passing out of the experimental stage and I was fortunate enough to come in just as it was possible to bring the process into profitable operation. The result was that the company immediately began making money, a change that soon attracted the attention of the other mill-owners in the district.

Did you treat any large tonnage by means of this interesting old process?

According to the standards of the present day, the plant was small, having a capacity of 18 or 20 tons per diem. As soon as it was known that the plant was a success, H. Augustus Taylor, the owner of the Clear Creek works, offered me a much larger salary than I was getting, so, after giving the Hunt, Douglas & Stewart people sufficient time to obtain a successor, I moved and built for Mr. Taylor the Clear Creek Reduction Works.

This was a custom plant, I suppose?

Yes, the Clear Creek works consisted of a Krom dry-concentrating mill, which, while somewhat difficult to operate, made an exceedingly clean lead-concentrate, but the middling, which consisted of pyrite and blende, carried a large amount of silver and was unsaleable. The mill that I erected was designed to treat this material, which it did very successfully.

By what method?

While at the Stewart mill I found that when the ore carried a high percentage of zinc and was roasted at a low temperature, chloride of zinc was formed, which acted as an excellent solvent of silver, and in building the Clear Creek works they were designed to use the zinc in the ore and the resulting chloride as a solvent for the silver.

Please describe the process.

The middling from the concentrator was crushed to 60-mesh and roasted at a low temperature, thus producing the maximum amount of silver and zinc chloride, after which the red-hot ore from the furnace was run directly into an agitator, where the silver passed almost immediately into solution. Then the agitator was stopped, and the solid matter given sufficient time to settle, after which the clear liquor was drawn off with a siphon and run over copper plates, which gave us a beautiful crystalline precipitate of silver, the dissolved copper being recovered on scrap-iron.

That is very interesting. Did you remain long at Georgetown?

About a year and a half; then I went to Caribou, also in Colorado, to build a similar mill for the Native Silver Mining Co.

You used exactly the same process and also successfully?

Yes, and very successfully; but one winter at Caribou was enough for me. The mill was covered with snow for four months, so that nothing was visible but the ventilator and the smoke-stack, and we had to tunnel through the snow from the assay and general offices to the mill.

So you sought a change, and whither did you go?

I had an offer to go to Silver Peak, Nevada, as engineer to build a similar mill to the ones at Caribou and Georgetown. After being there for about a year, the manager was taken ill and recommended that I be appointed his successor.

What company was that?

The Silver Peak Mines company, which was then controlled by John I. Blair of Blairstown, New Jersey.

What sort of an extraction did you get by the use of this leaching process and what was the approximate cost per ton, if you can recall it?

Comparing the assay-value of the ore with the amount in the tailing, the recovery would figure 95% to 97%, but, of course, that did not include the loss by volatilization during roasting, so that the net result was probably in the neighborhood of 93% to 94%. At Silver Peak the milling cost was unusually low owing to the fact that we had an enormous deposit of salt a stone's throw from the mill.

If you cannot recall the actual cost, and that isn't at all surprising considering how long ago it was, perhaps you can recall the average grade of the ore, which would show how rich it had to be in order to conduct operations at a profit.

The Silver Peak Mines company owned two groups of claims, one nine miles from the mill and carrying gold ore, the other four miles from the plant and carrying silver only. The new mill was built to treat the silver ores, which had an average yield of not far from 50 oz. per ton. The silver mines were soon exhausted, and after this we turned our attention to the gold mines, which had at one time been operated by Prof. Clayton.

What were his initials—J. E. Clayton?

Yes, Prof. Joshua E. Clayton.

He was a notable figure in mining in those days.

Yes. Further prospecting and development on the gold mines brought to light better ore than Prof. Clayton had been treating, with the result that the gold mines immediately became very profitable, the average recovery from the ore milled being about \$12.50 per ton.

You were using stamp-milling and amalgamation?

We were using the old-fashioned stamp-mill with bat-

tery and copper-plate amalgamation, the same as was used by Clayton. John I. Blair, who was known as an exceedingly grasping multi-millionaire, became so excited over the profitable operation of the mines that he tried to

Long enough to freeze them out?

No, he never succeeded in freezing them out, but his heirs sold the mines to the present Pittsburgh Silver Peak Mining Co.



HAULING ORE BY A 16-MULE TEAM FROM THE SILVER PEAK MINE TO THE MILL IN 1879

buy out the minority stockholders. They, of course, under the circumstances, refused to sell, whereupon Mr. Blair told them that if they did not sell he would shut

Now we will return to you. When did you quit?

In September 1879, when Mr. Blair sent orders to me to close the mines down, pay all the bills, and put a com-



THE SILVER PEAK MILL IN 1878

the mines and keep them shut-down as long as he lived, which was exactly what he did!

How long did the old rascal live?

For a long time, but I do not remember the date of his death.

petent watchman in charge. Just at this time the discoveries at Leadville were attracting the attention of everyone, and after fulfilling Blair's orders and seeing that everything was in shape for a permanent shut-down I went to Leadville, traveling by sled from Georgetown,

arriving at Leadville early in the winter of 1879.

Leadville, I presume, at that time was booming?

It was indeed. At that time Leadville was the Mecca for adventurers of all kinds, and everything was crude: ore was being shipped as rapidly as transportation facilities would permit, or as fast as it was treated by small local smelters. In the spring of 1880 a strike occurred, but it was of short duration. After that Leadville continued to grow with mushroom-like rapidity. One of the first things I noticed was that the surface ore, especially on Carbonate and Fryer hills, carried little or no lead and could be treated readily by what was known as the Washoe process, a method for extracting silver developed on the Comstock. F. M. Taylor and I built a mill in California gulch for treating this material, which we operated successfully for a number of years. After the operations of the mill were so stabilized as to require little metallurgical attention, I began engineering work for different companies in Leadville, the first of them being the Robert E. Lee, and subsequently for the Dunean, Wolfstone, A. Y. & Minnie, and the Dinero. Later I was made manager of the Colonel Sellers mine, which at that time had the largest output of any mine in the district.

What was the character of that output?

The ores near the surface were argentiferous galena, but as depth was gained a considerable percentage of blende began to appear and soon the amount of it became so great that the zinc penalty imposed by the smelters materially interfered with our profits. After some study and experimenting, I designed and erected a mill to separate the galena and blende, which was completely successful.

What was the nature of your process?

Wet concentration by means of high-speed jigs and Frue vanners.

What sort of a product did you make?

The jigs made an excellent lead product with a very small tailing loss, but owing to the large amount of water flowing over them the vanners were not so successful. To remedy this, I designed a dewatering system by which we could put the pulp on the vanners at any degree of density we desired. This brought the recovery on the Frue vanners up nearly to that of the jigs.

Can you recall the percentages?

No, I can not. The A. Y. & Minnie mine was contiguous to the Colonel Sellers, and in mining they followed through much the same cycle as the Sellers. As soon as Messrs. Graham and Guggenheim, who owned the A. Y. & Minnie, knew of the success of the process for separating blende and galena on the Colonel Sellers, they asked me to build a similar mill for them, which I was glad to do, and as the ores were identical the mill was a complete success.

If I recall correctly, the connection of Meyer Guggenheim with the A. Y. & Minnie was the foundation of the Guggenheim dynasty in the United States?

I believe so. At that time Benjamin Guggenheim was

in the office of the A. Y. & Minnie and later he was persuaded by E. S. Holden to invest some of his father's money in a smelter at Denver. This was the first link in the chain of Guggenheim smelters, which now reaches across the United States, Mexico, and Chile.

So you had an interesting experience with the treatment of the complex silver-lead-zinc ores?

We had sense enough to know that the blende, which was not saleable then, would some day be valuable, and we built large log cribs on the side-hill, in which all of the blende separated from the galena in both the Colonel Sellers and the A. Y. & Minnie ores, was stored. It was many years before this blende-concentrate became marketable, but ultimately it became valuable and was sold at remunerative prices to the Empire Zinc Company.

How long did you remain at Leadville?

Until 1886. At this time the mines in Aspen had come into prominence and the dispute between the different owners had culminated in a number of important apex-sideline lawsuits. As I had acted as engineer for the law firm of Patterson & Thomas in a number of mining suits, they asked me to go over to Aspen and assist them in their litigation. The suits were tried in the Federal Court at Denver, and after I had been on the witness stand all day I was asked to come to the attorneys' office that night. When I entered the room in fear and trembling, expecting censure for sins of omission or commission on the stand, I found the sideline mine-owners of the district all there. D. R. C. Brown, who acted as spokesman of the party, said, "We want you to come over to Aspen and take charge of our work". I replied that I had a comfortable home and a good position at Leadville, and did not want to move. The spokesman for the owners then said, "How much money do you want to sell out at Leadville and move to Aspen?" I mentioned a sum that I thought large enough to block proceedings, and the reply was, "You can't come too soon!"

So you agreed to sell out?

Their acceptance of my offer settled the matter, and as soon as I could arrange my own affairs and those of the Colonel Sellers I moved from Leadville to Aspen.

Were you married at this time?

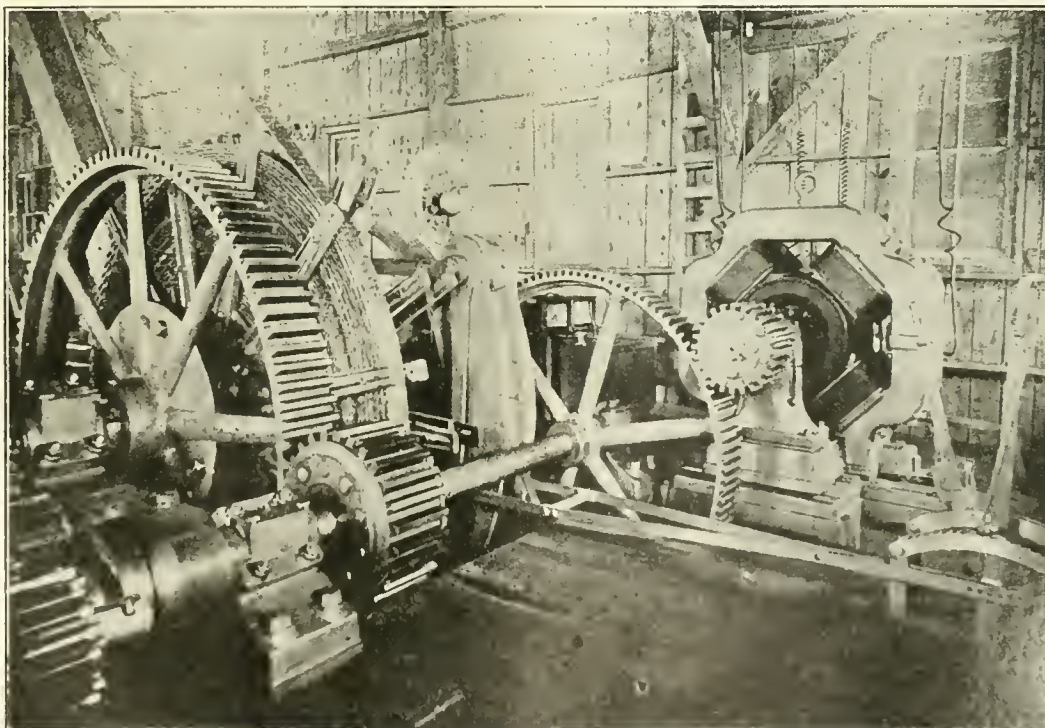
Yes, I was married in 1885 to Miss Katharine Kemble of Kingston, New York, and at this time we were living very comfortably at Leadville and had one son.

So you moved to Aspen?

Yes. The apex-sideline suits involved mines on both sides of the Roaring Fork and for the first few years my work was confined to developing the mines for both economic and legal purposes, and handling the details of these suits. As soon as they were settled I was made manager of the Della S., the Free Silver, and the J. C. Johnson mines. On the Smuggler Mountain side of the district the difficulty of hauling the ore down the mountain and the depth from which water had to be raised made a more economical method of mining necessary, and the Cowenhoven adit was started and driven to afford



TIMBER FRAMED FOR USE IN THE COWENHOVEN TUNNEL.



ELECTRIC HOIST AT THE FREE SILVER MINE, AT ASPEN, IN 1895

cheap drainage, transportation, and ventilation for the mines of Smuggler Mountain and beyond.

What was the length and size of this adit?

The Cowenhoven adit had a length of two and a half miles, a width of 7 ft. 8 in., and a height of 7 ft. It was double-tracked throughout, and between the tracks was a covered waterway 12 in. deep and 16 in. wide.

Do you recall the cost of building this adit?

The cost of construction varied greatly according to the character of the rock through which the adit was being driven; it averaged about \$20 per foot. At one point, for several hundred feet, we drove through soft porphyry, which crushed the timbers almost as fast as they could be put in place. At other points we ran through large open caves filled with dolomitic sand and broken rock necessitating the use of driven spiling. The weight on this spiling was so great that under the old-fashioned tail-block system of driving, the planks were battered and split before we could drive them into place, and I devised a new method of holding spiling in place, best described as a swinging false set.

Will you kindly describe it in more detail?

Under the old system the spiling was held in place by a block between the new plank that was being driven into place and the spiling on the last completed set. Under the new system no tail-block was used, but instead a light steel arched cap was pivoted over the sill last put into place and on this cap rested the forward end of the spiling that was being driven. The spiling was 3 by 6-in. plank cut to a chisel-edge. The false set carried the forward ends of the spiling and they were driven into the face, the forward movement of the false set being controlled by means of screw supports.*

Did you use square sets?

We did at first, but soon found that square sets would not stand the pressure and we were obliged to replace them by arched sets such as are used in railroad tunnels. In some places where the adit ran through crushed shale or softened porphyry the sills were pushed up so that we were obliged to replace them with inverted arches.

I suppose today, if you were to construct a similar adit in such yielding ground, you would use reinforced concrete?

Yes, provided that the probable life of the ore deposit were sufficient to justify the expense.

You will recall, I expect, the early introduction of electricity in mining operations at Aspen. That must have some historic value.

I believe that electricity was first used underground in Aspen in 1888, when a 10-hp. electric hoist was placed in the Veteran tunnel by W. B. Devereux. When the ore deposits of Smuggler mountain were found to extend well below the Cowenhoven adit, in order to sink inclines at distances of from one to two miles from the mouth of the

tunnel, electric hoisting was the evident solution of the problem, and all of the mines operating below the adit were equipped with electric hoists. Later, when the inclines below the Cowenhoven adit attained considerable depth, it was considered advisable to sink a shaft from the surface not far from the mouth of the tunnel, and the Free Silver shaft was started. This shaft had a depth of 1200 ft. and its pumps a capacity of 4000 gal. per minute. The electric hoist, which I designed for it, was for many years featured in the General Electric Co.'s catalogues as the largest electric hoist in the world, but compared with some of the electric hoisting-plants now installed in this country and South Africa it was a very small affair.

Mr. Brunton, I know that you were connected in a professional capacity with important operations at Butte. When did that connection begin?

In 1890, while I was still connected with the mines at Aspen, Messrs. Patterson & Thomas were appointed attorneys for the Little Darling mine, which at that time was engaged in apex-sideline litigation with the Blue Bird mine near Butte, and they made the point to the Aspen mine-owners that the Little Darling was a sideline mine and that some points in that contest were so similar to those at Aspen that the legal decision in the Butte case might have an influence on the Aspen case, in view of which the Aspen owners consented to my going to Butte and taking engineering charge of the litigation.

Who owned the Darling mine?

James Murray, who was a great friend of Marcus Daly. This suit never came to trial because we forced the Blue Bird owners into an untenable position and they were obliged to buy the Little Darling.

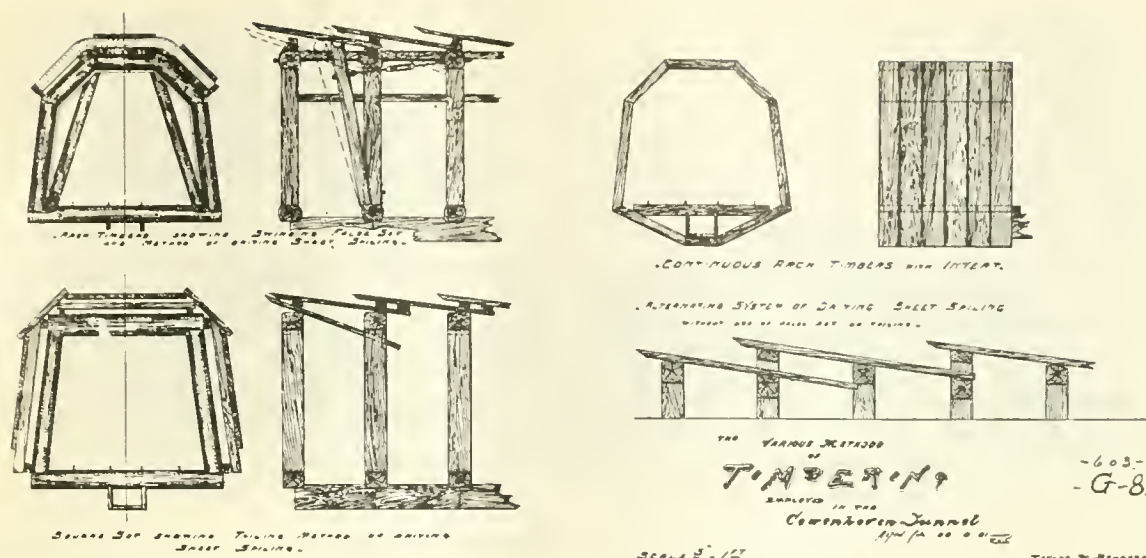
Who was running the Blue Bird then? Was it William Keller?

No, Robert Boraem was manager and William Keller was engineer. After the transfer Mr. Daly, who had been following the progress of the suit with a good deal of interest, asked me to become consulting engineer for him, which I did, and remained with him until he sold the Anaconda mines to the Amalgamated Copper Company.

So you again became a participant in apex suits?

Yes, but at first the work consisted almost wholly of studies in economic geology, and as Daly was continually branching out and buying new properties, the amount of work involved was much greater than any one engineer could possibly take care of. I mentioned this to Mr. Daly and he immediately said, "There's no strings on ye", which meant that I was free to make whatever arrangements I saw fit, and I then engaged Horace V. Winehell as geologist. The importance and value of the geological work carried on was so manifest that quite a staff of engineers and geologists was soon employed under Mr. Winehell's direction. At this time litigation was impending between the Daly and Clark interests in Butte, which later culminated in the Colusa-Parrot v. Anaconda suit.

*A fully illustrated description is given in Proc. Inst. C. E., 1898, pp. 289-306.



DIFFERENT TYPES OF TIMBERING USED IN THE COWENHOVEN TUNNEL

This was the beginning, I presume, of the long series of litigations in Montana and also of the political warfare between the opposing factions?

Yes.

I would like to ask you to what extent the work done in connection with the litigation led to the discovery of orebodies, that is to say, to what extent it was economically valuable to the mining district.

It was of extraordinary value to the mining district, because it was during the progress of our studies that we gained the first inkling of the complicated fault-systems in Butte, the unraveling of which has enormously cheapened development and added greatly to the amount of recoverable ore. The economic value of this geological work was not at first well understood by the superintendents of the different mines, but later, in order to fully utilize the work of the geologists, we devised a new system of mine-mapping that has been highly developed by the geological staff at the mines, so that today they have undoubtedly the best and most useful set of geological mine-maps in existence.

To whom would you give credit for the development of this interesting system of mine-mapping?

The beginnings of this system I devised at Aspen to enable us to follow and locate the faulted portions of the different veins. When we came to apply it to Butte this system had to be greatly elaborated and has been still further developed and improved by Mr. Winchell and his successor, Reno Sales.

What is the principle underlying this system?

The surveyors make the ordinary mine-map, from which the geologists take off individual level-sheets, copies of which they carry into the mine and place the geology on the sides of the openings exactly as exposed in the workings. Then, for the working-map in the office, we take a tracing on vellum of each individual level and place these sheets in what might be termed a large loose-leaf holder so that they occupy the exact position with

relation to each other that they do in the mine. On each individual sheet there is platted not only the workings but the geology, and as you can read through about two or three sheets of vellum it is easy to see the relation of the workings, faults, and orebodies to each other. Under the old system the mine superintendents and foremen took but little interest in the geological maps, but as soon as the new system was introduced we found them spending a considerable portion of their time each day studying these maps and drawing inferences from them.

The use of this transparent vellum is comparable to the information obtainable from the model of a mine, by visualizing the relations between the workings and the discoveries of ore to each other, is it not?

Yes, but I think that maps of this kind are more convenient and useful than any model I have ever seen. The next step was for the mine superintendents, and even the foremen, to ask the geologists to go with them through the mines and discuss the exposures at each point where there was a difference of opinion, so that in a short time after this system was put into use both superintendents and foremen were working in close harmony with the geologists.*

Now, Mr. Brunton, I want to put a delicate question. I would like your opinion as one better versed in mining litigation than any man, with the exception of Dr. Raymond if he were alive, as to the system whereby geological evidence is brought before the Court. I would like to ask you to look back upon your experience and to tell me, and tell our readers, whether you can suggest a better method of making the Court acquainted with the technical aspects of apex controversies.

The best method of placing actual mine conditions before a judge or jury is by some graphic method of visualization. Verbal descriptions of mine-workings convey little or nothing to a man who has never been under-

*A full description was published in Trans. A. I. M. E., July 1905.

ground. In some suits the attorneys deliberately challenge and reject from the jury a man who knows anything about mining, under the plea that he is probably already biased for or against the apex-sideline law, so that such juries are necessarily composed of men unacquainted with mining. As these men know nothing about mining law, and care less, they generally decide a suit in accordance with their sympathies, which are always with the side that they understand best: hence the necessity in a mining suit for introducing models, colored maps, and anything that will enable the jury to visualize conditions better than they can from verbal descriptions.

But most suits nowadays come before the Federal courts and are not tried before a jury, but before a judge. What I wanted to ask you particularly was whether the method of bringing evidence before the judge could not better be done by so-called experts or specialists not in the employ of the litigants but engaged by the Courts—even if secured by the Court under an agreement between the litigants?

I believe that such a method would be very much preferable to the present one, for the reason that it would then be possible to obtain unbiased testimony from the experts. While a witness is under oath he, of course, is obliged to describe conditions exactly as they occur, but his deductions from such observations are often biased by the opinion and attitude of his associates, and we all know that during the preparation of a lawsuit the men become enthused with their particular views and the mental attitude of one witness reacts on his fellows, and by the time the case is tried the experts are usually almost as partisan as the attorneys.

By the way, you have had some experience as an expert witness in British Columbia. Have they not a system there that is different from ours?

I have not taken part in any Canadian mining lawsuits, but, as engineer for the sub-contractor on the Canadian Pacific five-mile tunnel through the Selkirks at Rogers Pass, I was dragged into the litigation between my employers and the contractors. Many geological questions were involved in these suits and both sides freely availed themselves of the best geological talent in this country and in Canada, so that the testimony in many ways resembled that in an apex-sideline mining suit. During the trials I was particularly struck with the dignity and expedition with which these cases were conducted. Waste of time, through baiting of witnesses and wrangling between attorneys, was absolutely prohibited, and the judge had two assessors with him on the bench as advisors. These men were selected by the judge in chambers, were paid by the losing side, and the judge conferred and consulted with them on all technical questions arising during the trial. In both of these suits, the men selected to act as assessors were well qualified for the position, one of them being the most prominent civil engineer in the Province, and the other the largest railway contractor.

I remember you told us how you first became associated

with Mr. Taylor. I know from my residence in the West that Taylor & Brunton is a firm that has been associated for several decades with the sampling of ores. Will you please tell us how you first got into this business and something about the technique of it, if the secrets of the business may be divulged at this late date?

When I was engineer for H. Augustus Taylor in 1876-'77, his son, my present partner, Frank M. Taylor, was acting as business agent for his father, and the old gentleman always insisted that Frank and I should go into partnership. He said the combination would be an advantageous one for both of us, and talked so much about it that we finally followed his advice.

That was in what year?

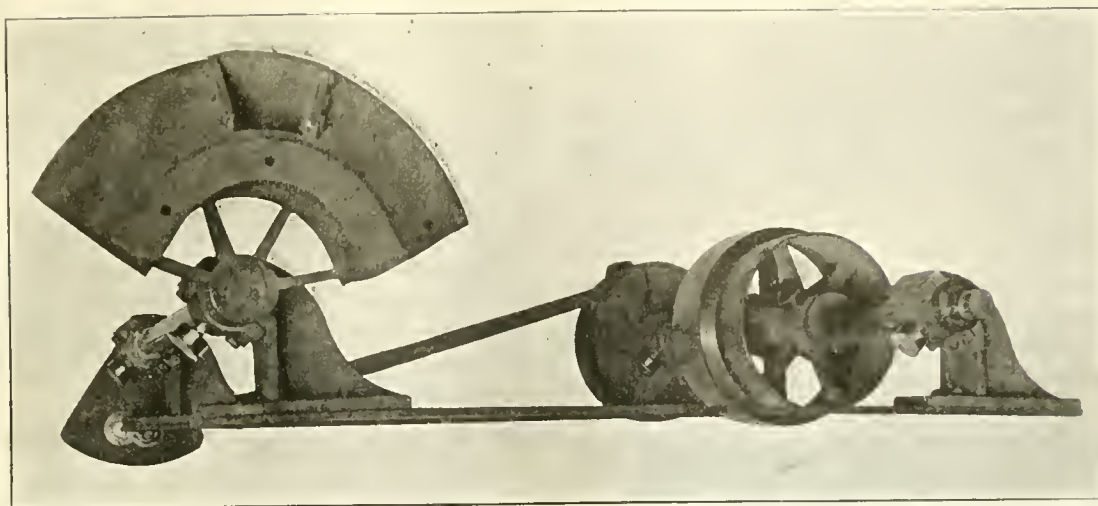
That was in 1880.

How did you get into the sampling business?

Through testing sampling machines and methods for the smelters. In lead smelting it is more economical to obtain a correct smelting mixture by a judicious mixing of ore than by adding dead flux. If these ores are obtained by purchase from different owners it is important that their exact composition should be determined before mixing them on the bedding-floor, therefore, coincident with the growth of lead smelting in this country came the demand for more accurate sampling. The old-fashioned methods such as the divided chute, whistle-spout, split-shovel, riffle-board, and Cornish quartering, no longer sufficed, and a more speedy and exact method became almost a necessity. Various mechanical devices were invented for this purpose, and I was often called by the smelting companies to pass upon their accuracy, but always found them deficient in some important particular. This was hardly to be wondered at when we consider that the same machine must give accurate results whether the ore passing through it be rich or poor, wet or dry, coarse or fine. Later on, in thinking over the sampling problem, the idea occurred to me, why not make a division of time, which is something that can be divided with exactitude and to infinity. At first I was unable to tie this idea to any workable mechanical contrivance, but later succeeded in doing so, the result being the present oscillating time sampler, which is acknowledged by everyone to give absolutely accurate results independent of the physical condition of the ore or the bias of the operator.

You are referring to the taking of the entire stream of ore for a fractional portion of the time?

Yes. I was fortunate enough to obtain a basic patent on the device for doing this, but other methods of obtaining the same result have since been devised, the most successful being the one invented by H. A. Vezin. Soon after the introduction of the Vezin type of sampler, an ingenious but unscrupulous engineer, who unfortunately is still at large, devised a means of interfering with its accuracy. Vezin was a man of unusual ability and sterling honesty, and when he found that the device on which he had spent so much time and study could be



THE BRUNTON OSCILLATING TIME-SAMPLER

tortured into giving an incorrect sample, it almost broke his heart.

What is the method?

The intake spout on the Vezin type of sampler is in the form of a sector, and unless its cutting edges are exactly radial the proportion of sample taken from all parts of the falling stream will not be equal, consequently it is only necessary to arrange the delivery spout so that the portion of the stream carrying the greatest proportion of coarse ore (which is usually the lowest grade) will fall through that part of the deformed sector which will take the largest proportion of sample. As the radial cutting edges on this type of sampler are of considerable length, their deformation by accident or design is extremely easy. A series of tests made at Cripple Creek shows that a slight displacement of the radial cutting edges with a conveniently arranged delivery spout would account for a difference of 10% in the sample.

Is it possible to interfere with the accuracy of the Brunton time-sampler in the same way?

No, the parallel cutting edges on the oscillator are so short and stiff that it is impossible to do anything that would interfere with the accuracy of the sample. We are so firmly convinced of this that we do not hesitate to allow men in our mills, who have interests in leases, to sample their own ore.*

Your name is also associated with the well-known pocket transit. What led you to invent this useful instrument?

When I first began the examining of mines an engineer was obliged to carry a small satchel full of instruments; I rebelled at carrying such a load and endeavored to devise a single instrument that would perform all the operations necessary in ordinary mine examinations and

reconnaissance surveys. At first the results were disappointing, but, by continued change and improvement, I succeeded finally in producing an instrument that was in every way satisfactory. At that time I had no thought of selling or patenting it, but simply had it made for my own personal convenience, but I soon found every time I went into a mine that the superintendent or manager would say, "Where did you get that instrument? I want one", and when I returned to Denver I would be obliged to order one, two, or three of these instruments for them. By and by the demand became so great that I patented it, in 1904, and made arrangements for its manufacture.

When did you manufacture your first instrument and who are manufacturing them now?

My first two or three instruments were made by Negretti & Zambra of London, in 1900 and 1901, but the length of time required to carry on correspondence about desired improvements and changes was so great that I finally arranged for the manufacture of the instrument with William Ainsworth & Son of Denver, who are still the sole manufacturers under all of my patents.

I understand that the instrument was used during the War.

The engineers who went into the Army naturally took their pocket-transits with them, and they proved so useful at the front that we had a steady flow of orders both from the Government and individual officers, and the military type of my instrument, which carries in addition to the usual graduated circle, a radium dial for night-surveying, and an alidade attachment for plane-table work, has been adopted now as standard equipment in the United States army. The military surveying instruments are all graduated from zero to 360° counter-clock so as to read azimuths directly from the north end of the needle, instead of being graduated from zero to 90° in quadrants as usually ordered by mining and civil engineers. There is much less opportunity for error in recording surveys by azimuths than by courses, and I

*For full illustrated description see 'Theory and Practice of Ore Sampling', Trans. A. I. M. E., 1895, and 'Modern Practice of Sampling', Trans. A. I. M. E., 1909. Also Bureau of Mines technical paper No. 86, on 'Sampling Conditions in the West', by T. R. Woodbridge.

would unhesitatingly recommend that all engineers adopt the military system. During the War, at the request of the military authorities, a slight variation of the standard pocket-compass was designed for use as a fire-control instrument for non-portable machine-guns. For this purpose the Government purchased 1500 of them. These instruments, of course, were graduated under the French mil system.

What is that?

Our system of dividing the circle into 360° means practically nothing, as we might just as well have divided the circle into 200° or 400°. A French military officer, some time before the War, conceived the idea of dividing the circle into 6400 parts, which he calls mils, the peculiarity of a mil being that it is approximately one-thousandth of the radius, consequently a deflection of one mil at 1000 metres distance would mean one metre; two mils, two metres; etc., thereby enabling many problems relating to gun-pointing to be performed mentally and with ease and rapidity. In fact, this simple but brilliant invention has proven an important factor in the wonderful efficiency of French field-artillery.

When did you become interested in Cripple Creek?

I went to Cripple Creek in 1894, but we did not build our first sampling-mill there until 1896, the second and larger plant being built in 1901. Later, when the mines of Cripple Creek became so deep that the expense of individual pumping became prohibitive and some central system of drainage became necessary, the Mine-Owners Association asked me to study the problem and decide on a method to be employed. Topographic surveys of the district and a study of the amount of water coming into the different mines showed that the most economical method of drainage would be by driving a drainage adit, and my recommendations were made accordingly.

What was this adit called and what is its length and the amount of water tapped?

This drainage adit was promptly christened the Roosevelt Tunnel, by which name it is generally known. Its length from the portal to the principal watercourse in the ore-zone is 17,200 ft. The amount of water flowing from the tunnel when this watercourse was first tapped was 12,000 gal. per minute, which has gradually diminished until today the flow is less than 1000 gal. per minute. The contractors for this tunnel elected to use the old Leyner rock-drill, and later Mr. Leyner sent them up a new small pneumatic water-feed hammer-drill for straightening out the sides of the bore and removing inequalities from the floor. To the astonishment of everyone, this little hammer-drill did faster work than the big piston-drills, and it was clear that a new mining tool had been developed which marked a great forward stride in rock-drilling machinery. It took some time for me to persuade my old friend William L. Saunders, president of the Ingersoll-Rand company, that a new drill had been invented which promised to revolutionize the rock-drill industry, but at last he came out to Denver and after an examination of the Leyner hammer-drill did

not rest until he had purchased all of Mr. Leyner's patents and engaged him as consulting engineer for a five-year period. The Ingersoll-Rand company immediately used their vast resources to improve and perfect this drill until today machines are being produced under this system that will drill 12 inches per minute in hard granite.

Cripple Creek is pretty quiet now, is it not?

Cripple Creek, of course, is not as lively now as it was in 1900, when it had a yearly output of \$18,000,000, but a district which has produced \$315,000,000 in 29 years and is still producing at the rate of \$5,000,000 per annum is very far from being defunct.

Did you take part in apex litigation in Cripple Creek?

Yes, as consulting engineer for the Golden Cycle company, during their litigation with the Vindicator. This suit, however, never came to trial, as it was settled by a consolidation of the two companies. One of the models built for this suit, however, is worthy of mention. It became probable that an important factor in the case would be the showing in the discovery shaft of the Golden Cycle mine. Just how to present the facts shown in that opening to the jury puzzled me for some time, but I finally hit upon a plan that proved eminently successful. The Natural History museum in Denver had brought out an expert from New York to make rocky backgrounds for the different animal groups in the museum; these were so beautifully done that anyone interested in geology could not help noticing them. Just at the time this expert had completed his work and was about to return to New York, it occurred to me to ask him if he could not reproduce the discovery shaft of the Golden Cycle, to which he agreed, and in two months made a model that was an absolute reproduction of the discovery shaft in form, texture, and color. I think this method of showing conditions can be used successfully in many cases. The gentlemen on the opposite side of the case, when once the suit was settled, were quick to acknowledge that this reproduction of the shaft would have meant their certain defeat had the case come into court.

Are your sons mining engineers?

Only one of my sons elected to study mining engineering, and, on the completion of his sophomore year at the Colorado School of Mines, he went on a surveying trip during the summer to North Park, where he became enthused over pure-bred stock-raising and absolutely refused to go back to college. There was nothing to do but to let him follow his bent, in which I was much disappointed; but perhaps it is all for the best, as Jack is now owner of the Glendale stock-farm and has made a greater success in raising pure-bred polled Herefords than he was likely to do in mining engineering. My oldest son, Fred, was graduated as metallurgical engineer from McGill University and is now in Mexico. My youngest son, Harold, graduated with honors as mechanical engineer at the University of Colorado and is engineer for the Plains Iron Works of Denver. My

son-in-law, G. B. Shanklin, is an electrical engineer engaged in research work for the General Electric Company.

How do you compare the facilities for education in your day with those that your sons have been able to obtain?

The engineering colleges of today are so far ahead of their predecessors of forty-five years ago in personnel, apparatus, and equipment that present-day students have opportunities both in college and after leaving it that we old-timers never dreamed of. When I came West, mining engineers were scarce, and, worse than that, American mining engineers were not considered to be in the same class with the German. It took many years to convince the general public that the American

ences in Mexico and South America, I found the Spanish miner to be an exceedingly cleanly, skilful, and industrious individual. Of course, he has some racial characteristics, and among them is a dislike to being bossed. Out of this, and some other traits, has grown the curious and far from inconvenient system of working now in vogue at many of the mines. Guided by the unions and local custom, there has been established in each district what constitutes a standard day's work in all surface and underground occupations, and when this amount of work is performed the men receive from their foreman a ticket that they cash at the paymaster's window on their way home. This plan gives them an unusual degree of



PHOENICIAN IDOLS FOUND IN AN OLD STOPE AT RIO TINTO

engineers were better qualified to handle conditions in the West than foreigners.

I understand that you have made a number of trips to Spain. How were you impressed with Spanish mines and miners?

Spain is a country of wonderful mineral resources, and although many of the mines have been worked since prehistoric times, they are still far from being exhausted. Some of the largest producing mines of today were worked by the Phoenicians and furnished copper for the bronze that went into Solomon's temple, and have since been worked successively by Roman, Moorish, Spanish, and English owners. In early times, before the days of explosives, mining operations were necessarily slow and mines had some chance of longevity, but in recent years many of the oldest Spanish mines have been subjected to the most intensive attacks with modern air-drills and steam-shovels without seriously decreasing their reserves. Contrary to what I was led to expect from my experi-



ENGINEERS EXAMINING A ROMAN AMPHORA FOUND IN THE RIO TINTO WORKINGS. LEFT TO RIGHT: C. H. MACNUTT, W. A. CARLVIE, R. E. PALMER, AND D. W. BRUNTON.

personal freedom, as it allows them to begin work when they choose and they are free to quit whenever the day's stint is accomplished. Under this system most of the men begin work about 6 a.m. and by 1 p.m. the more energetic and skilful have completed their tasks and begin moving homeward. By 4 p.m. the mines are practically emptied.

In what particular work were you engaged while in Spain?

Consultation work for the Rio Tinto company. They especially wanted me to study and devise some means of recovering the enormous tonnage of ore left behind in the floors and pillars of one of their largest mines after it had been worked to the limit by the pillar-and-stall method. The immense size and great depth of this deposit, coupled with the prospect of self-ignition when large masses were allowed to move or slide, precluded all

possibility of using any of the established systems of mining. After a great amount of study, consultation, and experiment, a method was finally devised that has proven safe, economical, and completely successful in recovering all of the ore from these old workings.

Will you describe the system briefly?

It is a direct replacement system, taking full advantage of both surface and underground conditions as well as the habits and skill of the Spanish miners, but an intelligible description would require drawings that would be scarcely worth while, as I do not believe that such a complicated and exacting system could be successfully employed anywhere else on earth.

You did all that you could during the War, I am sure. In what particular service were you engaged?

When the United States entered the War, the different scientific and technical societies in this country held a series of meetings to decide what they could do to assist the Government, the result of which was that each society elected two members to represent them on a central body to be known as the War Committee of Technical Societies. Edmund B. Kirby and I were chosen to represent the American Institute of Mining Engineers, and H. W. Buck of New York was elected chairman of this committee. Shortly afterward pressure of work entailed by some large Government contracts, which his firm had received, compelled Mr. Buck's resignation. I was elected his successor and served in that capacity throughout the War. The War Committee soon found that with the various societies behind them they had an abundance of scientific and technical assistance but were grievously short of funds. The Naval Consulting Board, which had been created for some time, was in exactly the opposite position. Its members were all prominent busy men, many of them engaged in Government work, and they had little time to devote to the incoming flood of war inventions submitted to the Government, and after several consultations the War Committee of Technical Societies decided to co-operate with the Naval Consulting Board. This gave us offices, money, clerical and stenographic help, Government printing facilities, and a postal frank, by means of which we were able to accomplish much more than our original program contemplated. Later, I was appointed by Secretary Daniels a member of the Naval Consulting Board, and about the same time I was made a member of the Inventions Section, Plans Division, of the General Staff of the Army. *That was fine.*

The work assigned to the Naval Consulting Board, Inventions Section of the Army, and the War Committee of Technical Societies was the consideration of inventions submitted to the Government for use in the War. The great interest that the inventors and scientific men of the country took in the contest soon brought such an avalanche of ideas and inventions that our New York office had to be enlarged, and later, the Government asked that we move our headquarters to Washington, where we were given ample room and every facility for work.

Something like 135,000 ideas, suggestions, and inventions were submitted. The bulk of these, of course, were useless, but it took a vast amount of work and study to separate the few grains of wheat from the mass of chaff. Even among the meritorious inventions received, few were sufficiently perfected for immediate utilization, and a great amount of time and effort were required to develop and test them preparatory to manufacture. The French and English also had their Inventions Boards, which were in existence, of course, much longer than ours, and they also found that to develop, test, and put a new invention into quantitative production required not far from a year.

Were any of the suggestions or inventions put to fruitful use during the War?

Yes, some of them were; and had the War continued six months or a year longer some very important inventions would have come into general use at the front that would have done much toward convincing the Germans that General Sherman's description of war was correct. One of the most important results of the activities of the Naval Consulting Board has been the adoption of a plan for building a large experimental machine-shop and research laboratory for the Navy, on the banks of the Potomac, a few miles below Washington. For this purpose \$2,000,000 has been appropriated, government land set apart on which to build, and contracts let for the entire plant. This experimental shop and laboratory will be used not only for research work of all kinds connected with the Navy, but new inventions submitted from any source for naval use will be examined and tested and those which are found to possess sufficient merit will be developed, perfected, and carried forward to a point where they will be put into immediate use or held ready for quantity production in case this country should at any time be unfortunate enough to be forced into another war.

THE copper output of Alaska in 1919 was 47,220,771 lb., valued at \$8,783,063, states a U. S. Geological Survey report. This is less than the output in 1918, which was 69,224,951 lb., valued at \$17,098,563. During the year, 11 copper mines were operated, compared with 17 in 1918. Of these mines, 3 are in the Ketchikan district, 5 in the Prince William Sound district, and 3 in the Chitina district. The curtailment of copper mining was due to the fall in the price of copper and the uncertainty of the market. Throughout the War the small operator was hampered by lack of shipping to transport his ore and of smelters to reduce it, conditions that blocked the development of a number of properties and discouraged the copper-mining industry. Largely for these reasons there has been relatively little prospecting for copper during the last few years. Should freight-rates decrease or the price of copper go up, many small mines would resume operations and the larger low-grade orebodies would be developed. The average copper content of the ores mined in 1919 was 4.8%; they yielded an average of \$0.129 in gold and \$1.11 in silver per ton.



STRIKE AT THE PREMIER MINE IN BRITISH COLUMBIA

A strike involving 200 men has completely stopped operations at the Premier mine, situated in the Portland Canal district of British Columbia and controlled by the Guggenheims. According to dispatches, not only miners but the men employed in mill-construction and in erecting the new aerial tramway, have walked out. About the 4th or 5th of this month the company posted notices at the mine of a general cut in wages, ranging from 75c. to \$1.25 per day for various classes of labor, such cut to take effect the 16th of the month. This cut caused considerable discussion among the men, with the result that some 60 men, all of whom were handling ore, were discharged. The men apparently interpreted this as a manoeuvre to head off a strike; they quit in a body and deserted the mine, leaving no one except the office staff. The strikers have a number of grievances real or imagined. They find fault with the treatment of the 'old timers' at the hands of the mine manager; they complain of crowded bunk-houses and lack of recreation at the mine; and they resent the attitude of D. L. Pitt, the manager, as being generally "unreasonable" and antagonistic.

FINANCING FOREIGN TRADE

The War Finance Corporation has issued Circular No. 1 outlining, in a general way, the requirements of the Corporation in connection with applications for advances to American exporters and American banks, bankers, and trust companies for the purpose of assisting in the exportation of domestic products. The circular recites the law under which the Corporation is operating and sets forth the procedure that should be followed in making applications for advances. It also indicates the papers, documents, and other evidence required by the Corporation in connection with advances and includes suggested forms of application.

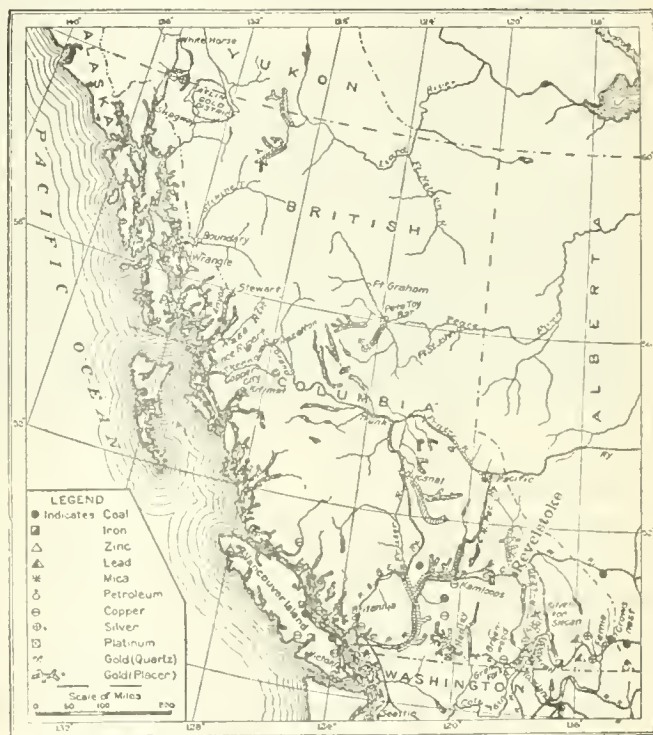
Copies may be obtained by exporters, bankers, and other interested parties upon application to the War Finance Corporation, Washington, D. C., or to the Federal Reserve Bank in the district in which they are situated.

COPPER-SELLING AGENCIES

The relative importance from the standpoint of output of the various groups of copper-mining companies is indicated in the following summary of the mines whose production is sold by different agencies. Guggenheim Brothers handle the marketing of more copper than any other interest in this country, representing as they do the so-called Hayden group of porphyries; also Braden, Chile, and Kennecott. Next on the list comes the United Metals Selling Co., which handles the marketing of copper for such important companies as Anaconda, Arizona Copper, Inspiration, Greene, New Cornelia, and North Butte. The Phelps Dodge Corporation ranks third in the list, representing its own properties as well as Arizona Commercial, Calumet & Arizona, Old Dominion, and United Verde Extension.

The companies marketing their copper through Guggenheim Brothers turned out approximately 500,000,000 lb.

last year, against 350,000,000 lb. by the United Metals Selling companies, and about 200,000,000 lb. by the Phelps Dodge companies. The American Metal Co. is an active selling interest and represents such companies as Cerro de Pasco, Granby, and International Nickel. W. P. Todd handles the marketing of East Butte and Davis Daly copper. Lewisohn & Sons handles the output of Miami and Tennessee Copper. The Calumet & Hecla sells its own production as well as that of its subsidiaries; also that of Hancock and Victoria. United Verde's output is sold through the United



British Columbia

States Smelting & Refining Co., and the American Metal Co., Copper Range, Mohawk, Wolverine, Mass Consolidated, Franklin, Magma, Mason Valley, Quincy, Shattuck-Arizona, and United States Smelting sell direct. American Smelting sells its own copper as well as that of Boleo, Gila, Howe Sound, and Ohio.

ARIZONA

Douglas.—The Calumet & Arizona company has closed its smelter. It will, however, keep the power-plant at the smelter in operation to supply power to the mines. All mining has been suspended and operating forces have been reduced from 2500 to between 40 and 50 men. These will be kept on the payroll to do underground development work. During the course of this work approximately 15,000 tons of ore per month will be hoisted. This will be shipped from the mines to the smelter and stored in the bins. These bins have a capacity of between 60,000 and 70,000 tons of ore.

Tombstone. The mill of the National Metals Recovery Co. is working two shifts turning out good concentrate. The plant has been working without a hitch ever since it started and recoveries made have been gratifying. The mill has a capacity of 100 tons per 24 hours. It is an economical plant working on the gravity system. It is in charge of J. W. Stockham. Bert Holland and associates have been turning out concentrate for the past few weeks in the mill erected at the foot of Emerald dump and while the water question hampered work a little it is now running in good order.

CALIFORNIA

Altaville. At the bottom of the 320-ft. shaft at the Victor gravel-mine a layer of blue clay, rich in gold, has been entered. Platinum also has been found in the black sand panned from the clay. Two assays of sand returned more than \$2000 per ton in platinum alone. A winze is being sunk to determine the depth of the deposit.

Angels Camp. High-grade ore has been uncovered on the 500-ft. level of the Angels Camp Deep mine. John C. Benson states the vein contains free gold. It is believed to be the continuation of an important orebody opened some time ago on the 200-ft. level.

Coulterville. The Virginia mine, formerly owned by the White Gulch Mining Co., has been acquired by a newly organized company known as the Virginia-Belmont Mining Co. The new owners have resumed development work. The mine is fully equipped and the 750-ft. point has been reached. Jack Wilson is superintendent.

Death Valley Junction. The Pacific Coast Borax Co. is to resume shipments from the Death Valley mines about October 1, according to C. B. Zabriskie, general manager, who recently inspected the properties in Death Valley and also the newly found borax deposit in Clark county, Nevada. The company has completed the erection of a new dry-de-shaling plant, a patented process for removal of the shale remaining after the roasting. New Diesel engines and generators have been put in place and the capacity of the treatment plant has been enlarged 50% in expectation of increased business next year.

Grass Valley. After working for six weeks to unwater the shaft and drifts of the Grass Valley Boundary mine at the west edge of Grass Valley, attempts at holding the water were abandoned after the vein had been thoroughly inspected. It was found that the heavy winter rains had caused an immense flow of water into the shaft, and it was virtually impossible to hold it with the present limited equipment. M. J. Brock, the promoter and manager of the property, is now getting estimates on the plant required.

Jackson. Sinking has been started below the 4900-ft. level of the Argonaut mine. Forty stamps are crushing ore from the 4600-ft. level that is said to average \$15 per ton. Unwatering is still progressing at the Kennedy mine; production will start within 90 days, according to authentic reports.

Jamestown. The old Rawhide mine is being re-opened. Thirty men have started to sink a new shaft on the property. The plan is to sink 1800 ft. Ore taken out as shaft-sinking progresses will be crushed in a Gibson mill. Arthur Knowles and associates are in charge of the work. The mine produced \$7,000,000 prior to 1915, when the known resources were exhausted. A new ore-shoot has recently been discovered.

Nashville. O. A. Ingraham and C. A. Willhite have taken a lease of the Havilla mine from the Joshua Hendy estate. They say a ten-stamp mill will be erected at once and put in operation within 40 days.

Railroad Flat. The old Ghost gold mine is being reopened under the management of E. Saunders. This prop-

erty is one of the old mines of Railroad Flat district and holds a record for gold production.

Shasta. F. A. Zimmerman and J. A. Anderson have cut into the vein in their Gold Dollar mine just north of town. By running a tunnel 100 ft. they struck the lode at a depth of 100 ft. The showing is good.

Sutter Creek. Sinking has been resumed at the Hettle Green mine. Diamond-drilling has disclosed the existence of orebodies below the bottom level.

Improvements in the plant of the Central Eureka Mining Co. include the installation of a modern electric hoist to replace the present steam plant, and the erection of a steel head-frame, instead of the wooden structure now used.

The bins in the shaft are to be straightened and heavier rail will be laid. This will expedite the hoisting of ore and will permit more rapid lowering and raising of miners.

IDAHO

Coeur d'Alene. The high price of silver and the increase in the price of lead are encouraging the mining industry in the district, and many of the smaller operators are preparing for development work during the summer. The Bunker Hill & Sullivan company has a large force at work in the mine. The main shaft has been sunk to the 1600-ft. level during the last five months and the output of the mine is approximately 1200 tons of ore per day. Twenty-five men are at work re-building the east mill, which was destroyed by fire last summer. The new mill will have a capacity of 500 tons daily. The Sweeny mill is operating at full capacity, handling lessees' ore and milling the old Sweeny tailing dump. The Bunker Hill smelter is handling 100 tons of ore and concentrate daily, and during the last week shipped 70,000 oz. of silver to the United States Mint at Denver.

In the upper workings of the Bunker Hill & Sullivan the Reed Level Leasing Co. is employing 27 men; sufficient tonnage is in sight to continue work for several years.—The Stenwinder lease will resume work within a short time and ore will be milled by the Peoples concentrator. A number of lessees are at work in the old Last Chance and Sierra Nevada workings.—The North Bunker Hill Mining Co. has six men employed drifting on the 500-ft. level.

The Sterling Silver Co. in the Big Creek district has recently entered a vein of high-grade gray-copper ore and is planning further work.—The new mill of the Sunshine Mining Co. is well under way, lumber and equipment having arrived on the property in the last few days. Fifty men are employed on the Yankee Boy and Yankee Girl claims owned by the company.

Among the Pine Creek properties that have had favorable showings are the Highland-Surprise, situated a short distance from the Sidney; and the Constitution and Douglas on the east fork. Fred Ruch has been placed in charge of operations at the Sidney mine on Pine creek and will get out a shipment of high-grade ore from the surface showing. He also will start operations in the lower tunnel to cut the lode showing at the surface at a depth of over 400 feet.

The Peoples concentrator on Milo creek above Wardner is being overhauled and will commence operation within the next month. The entire mill is being repaired, a new set of rolls and a Dorr thickener are being installed. The concentrator has a capacity of approximately 100 tons of ore daily.

Ore shipments are going ahead from the Western Union mine. A car of ore was shipped recently and another is ready for shipment. The ore averages 44 oz. silver and better than 50% lead. Good progress has been made on the tunnel, which is in 200 feet.

Some conception of the importance of leasing operations in the Coeur d'Alene is obtained from the announcement that the Bunker Hill & Sullivan company last year received

\$69,226 from royalties paid by miners who lease from that company alone.

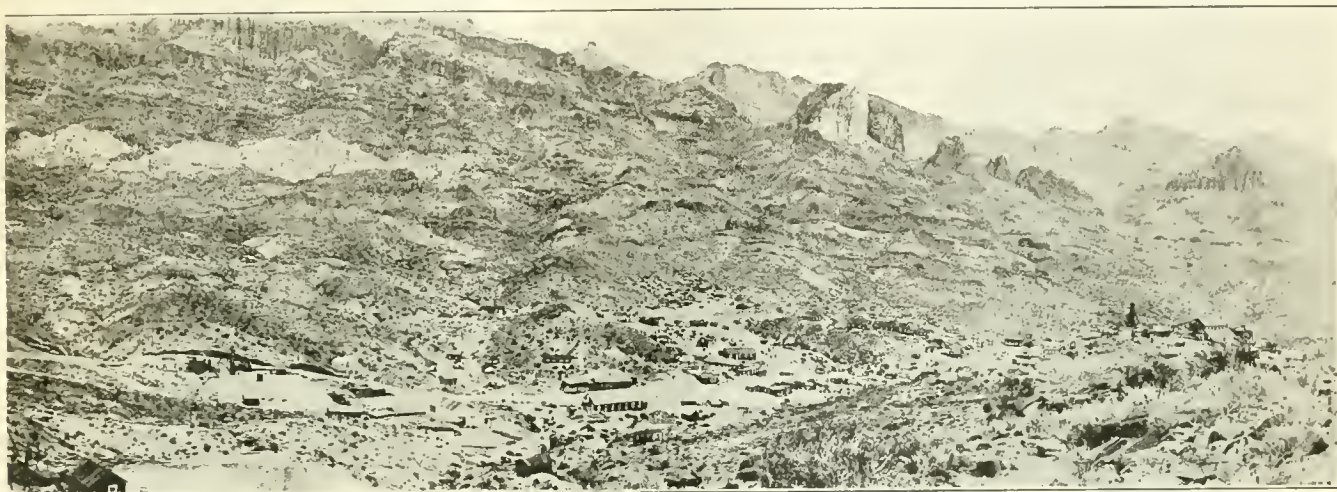
Pocatello.—The Idaho Leasing Co., operating the old Black Bear property at Mace, now owned by the Federal Mining Co., shipped its second car of ore recently. There are still two cars of ore in the bins. The ore is being shipped to the American Smelting & Refining Co.'s smelter at East Helena. The tram that has been under construction for several weeks has been completed and is in good running order. The concentrating plant will be slightly changed in order to add to the efficiency.

MICHIGAN

Houghton.—Settlement of the reparations matter will, local mining men believe, work to bring about an improvement in the metal market. They give several reasons for this belief. Trade with Germany and the allied countries will be placed almost immediately on a better basis, and

factorily. Efforts are now centred on drifting south from the 942-ft. level of the New Baltic shaft toward the New Arcadian shaft with which connection will be made at the 900-ft. level. Drifting north has been stopped temporarily. The south drift is in 120 ft. It is in the lode and the vein 'rock' is of encouraging character, samples showing barrel copper well distributed.

Mayflower is drilling southward from the east cross-cut at the 1700-ft. level in a section of what appears to be the Mayflower vein. Work in the west cross-cut has been temporarily abandoned. Operations there were successful in enabling the management to obtain accurate data as to the extent of faulted ground in that direction. In the east, the drills have passed through vein matter well impregnated with fine copper. The showing there is encouraging for a distance of fully 200 ft. Mayflower is nearer to the sandstone than other mines and has had fewer data to work on than any of the other properties. It has been discovered



Panoramic View of Oatman District in Arizona

copper, in their estimation, will be one of the first commodities to 'come back' in this revival. Germany, it is pointed out, is denuded of copper and must come into the market in greater volume than in the last few weeks. During the War, Germany not only used up all of its surplus stocks but stripped the country, confiscating roofs, bells, copper utensils, and even door-knobs to salvage the copper for munitions purposes. This metal must be replaced to a large extent, and Germany, too, will strive for maximum production in order to meet the allied demands. All this will require, it is believed, large new stocks of copper. Before the War, Calumet & Hecla disposed of about 70% of its metal to Germany. Since the War, Calumet & Hecla has had to rely entirely, with the exception of the last few weeks, on the domestic market. With little or no demand for the metal, however, copper has been piling up. The recent shipment of 200,000 lb. of metal to France by Calumet & Hecla may indicate the early return of France to the market. France has been relying largely on scrap copper salvaged from the battle-fields, but it is believed this stock has been largely exhausted.

Wolverine has completed the work of taking out the pillars on the 38th level of No. 4 shaft and is now at work on the 37th-level pillars. The 'rock' continues to average around 15 lb. of copper per ton. In conjunction with this work, drifts are being widened out and the backs of stopes removed in the upper levels. Wolverine is employing close selection in its mining. Wolverine will make no attempt to explore other lodes on its property until there is a marked improvement in metal-market conditions.

Development work in New Arcadian is proceeding satis-

factorily. Efforts are now centred on drifting south from the 942-ft. level of the New Baltic shaft toward the New Arcadian shaft with which connection will be made at the 900-ft. level. Drifting north has been stopped temporarily. The south drift is in 120 ft. It is in the lode and the vein 'rock' is of encouraging character, samples showing barrel copper well distributed.

Calumet & Hecla has installed a compressor, electrically operated, in the 81st-level cross-cut, east of the Red Jacket shaft, to supply air for the drills on the Kearsarge amygdaloid lode. This will result in a saving, for it will make it possible to suspend the operation of the big steam-compressor on the surface. There is no change in the Kearsarge lode developments, and stretches of good ground alternate with comparatively barren strips.

Seneca's third level, north, which is breasted 1500 ft. from the shaft, continues to open good ground, while the fourth-level stope, also in the north, is yielding the same high quality of rock that was noted from the beginning of this phase of the program. The fifth and sixth, north, also are in fair ground so that all openings are encouraging. About seventy men are on Seneca's payroll.

MISSOURI

Joplin.—The Eagle-Picher Lead Co. has resumed production on a normal scale. Recently 450 employees have been called back to work in the various departments of the enterprise.

MONTANA

Butte.—Ore mined by the Davis-Daly company during the first quarter of 1920 averaged 6.21% copper and 5.49 oz. silver. The number of men in the mining force has been reduced to about 200. Since the fan was started in the new ventilation shaft the average temperature on the 2700-ft. level has been lowered more than 20°. Surface improvements have been completed and the mine is now in a condition to operate to capacity, with the maximum of efficiency. Developments on the 2400 and 2700-ft. levels are gratifying. The Hibernia mine has continued to be of great value in offsetting the losses in the Colorado operations, the production of silver ore being the highest in recent years. The production by lessees at the Hibernia mine amounted to 18,147 tons, producing 361,059 oz. of silver, the average assay being 20.56 oz. per ton.

Great Falls.—One unit of the Anaconda company's smelter and one of the rolling mills at the plant have been placed in operation. Silver and lead ores are being treated, giving employment to 100 men. Other parts of the plant have been closed down, operation of the copper furnace-refineries having been suspended last week.

Marysville.—The following returns are reported from the mines of the Barnes-King Development Co. for April 1921. The Shannon mine shipped 3321 tons of ore, averaging \$8.44 per ton; the net bullion produced therefrom amounts to \$27,945. The North Moccasin lessees mined 1320 tons of ore, with an average assay value of \$6.15 per ton, on which the company will receive \$769 royalty.

NEVADA

Candelaria.—Construction of the first unit of a cyanide plant for the Candelaria Silver Mines Co. will begin at once, according to a statement made by C. D. Kaeding, consulting engineer and manager for the company. Crushing-machinery with a capacity of 400 tons daily will be installed and the first unit of the cyanide plant will treat 150 tons daily and will be completed by the time the electric transmission line from Hawthorne reaches the camp, probably late in August. The control of the enterprise is held by the International Nickel Co., one of the largest operating concerns in America, which operates the Dome Mines, Ltd., at Porcupine, and other large mines in Canada.

Fly.—The Nevada Consolidated Copper Co. milled 381,092 tons of ore, averaging 1.49% copper, during the first quarter of 1921. There was shipped direct to the smelter from the Ruth mine 5459 tons of ore, averaging 10.92% copper. Of the total tonnage treated, 66% came from steam-shovel workings and 34% from underground workings.

Lewis.—An 18-in. seam of \$4000 silver ore has been opened on the 150-ft. level of the Betty O'Neal at a point 450 ft. south of the shaft. The silver is in the comparatively rare forms of stephanite and polybasite, sulphantimonites. The vein where the find was made is 5 ft. wide and the ore aside from the rich seam assays \$30. There is 350 ft. of unexplored ground above this ore, which is in the Estrella vein, and a tunnel is now being driven to cut this vein 150 ft. below where the find was made. In the early days the Betty O'Neal was a good producer of rich ore and it is now being re-opened. An air-compressor was hauled to the mine recently from Battle Mountain, for use in driving a 2000-ft. tunnel that will cut the two veins at a depth of 1300 ft. It is estimated that it will require eight months to drive this tunnel to a connection with the 300-ft. level of the Betty O'Neal shaft, on the 150-ft. level of which the \$4000 ore was found. When this tunnel has been completed a 125-ton unit of a 500-ton concentration and cyanidation plant will be built at the portal. Money to bring the present plans to completion has been supplied by the George W. Sias Co. of Boston. The mine manager is Noble H. Getchell, son of L. W. Getchell, who formerly owned the property.

Ploche.—Official confirmation of the reported new finds of rich ore on the Nevada Silver Horn and Silver Dale properties at Silverhorn has been made. At Rattlesnake Point, about 300 ft. east of the mineral monument on the Nevada Silver Horn, J. Nelson Nevius has opened a body of ore, samples of which assay as high as \$100 per ton in silver. This has already been proved for a width of 10 ft. and a length of 40 ft. Good progress is being made in carrying out plans for prospecting the vein for 1200 ft. in length by means of three adits and a drift from the bottom of the Whipple shaft, there being a difference in elevation of about 70 ft. between each of these.

R. M. Geppert has completed a two months geological study and sampling of the Silver Dale and has left for his home in Minneapolis. Mr. Geppert uncovered what apparently is the source of rich float found some time ago on the south end of the Silver Dale. Assays of this float were rich; the ore in place is not so rich, but is promising.

Work on the Silver Peer is confined to the 120-ft. level, where the orebody is reported to average \$10 per ton for a width of 40 ft. Word has been received that Walter Geddes has sold a big interest in the Peer to Tex Rickard. Business houses of all kinds are being opened rapidly and Silverhorn is assuming the appearance of permanency. The rush into the district continues and the population is increasing rapidly.

Silver Peak.—An 8-ft. width of \$80 silver ore has been found in a 70-ft. shaft in a new district called Cow Camp, 12 miles south of Silver Peak. The work is being financed by a man named Sanger of Bishop, California.

Tonopah.—The Tonopah Extension has resumed work with 50 men and there are indications that the wage-cutting companies will continue to import miners until full crews have been obtained. Buildings are being prepared in which these men will be housed. There has been no trouble of any kind except that the rails were greased for a train reported to be taking in strike-breakers. Men returning to work are permitted to do so without interference. It is estimated that 25 to 30% of the number of men employed before the strike are now at work. Communications, one faction to the other, have only served to make certain the early indicated attitude of the operators that they would not make concessions. The quickness with which the wage-cut was announced by the operators is said to have been in retaliation for the suddenness with which the workers broke their agreement some months ago, when they refused to work under reduced wages previously agreed upon.

Virginia City.—At a depth of 170 ft. the new inclined shaft of the Comstock Silver Mining Co. is in ore assaying \$15 per ton across the full width. The shaft is following the dip of the vein. The ore contains gold and silver, showing coarse particles of gold in pannings, and is typical of the deposits of the Silver City part of the district, where the precious metals are found in association with manganese. —Development work is to start at once on the Overland property, adjoining the main group and which was purchased lately by F. M. Manson for the Comstock Silver Co. This property is equipped with a 10-stamp mill and complete mining plant and buildings and has produced over \$500,000 from its 550-ft. shaft on the Succor vein.

NEW MEXICO

Hurley.—During the first quarter of 1921, the Chino Copper Co. treated 345,660 tons of ore, a daily average of 3840 tons, or 611 tons less per day than for the preceding quarter. The ore averaged 1.69% copper, and the recovery per ton was 25.78 lb. There was produced 20,731 dry tons of concentrate, averaging 21.50% copper, resulting in a gross production of 8,913,405 lb., as compared with 10,457,661 lb. for the last quarter of 1920. The net cost per pound

of copper produced was 14.56c., as compared with 13.93c. the previous quarter. Payment for precious metals and miscellaneous income were equivalent to 0.81c. per pound. The operating loss was \$122,949, while miscellaneous income was \$69,812, leaving a net operating loss of \$53,136. Copper was carried at an average price of 13.13c. in arriving at the above figure. At the present time, Chino has about 300 men on the payroll. Over half of this number are Mexican laborers, who are in more or less destitute circumstances and to whom the company is giving employment at \$2 per day.

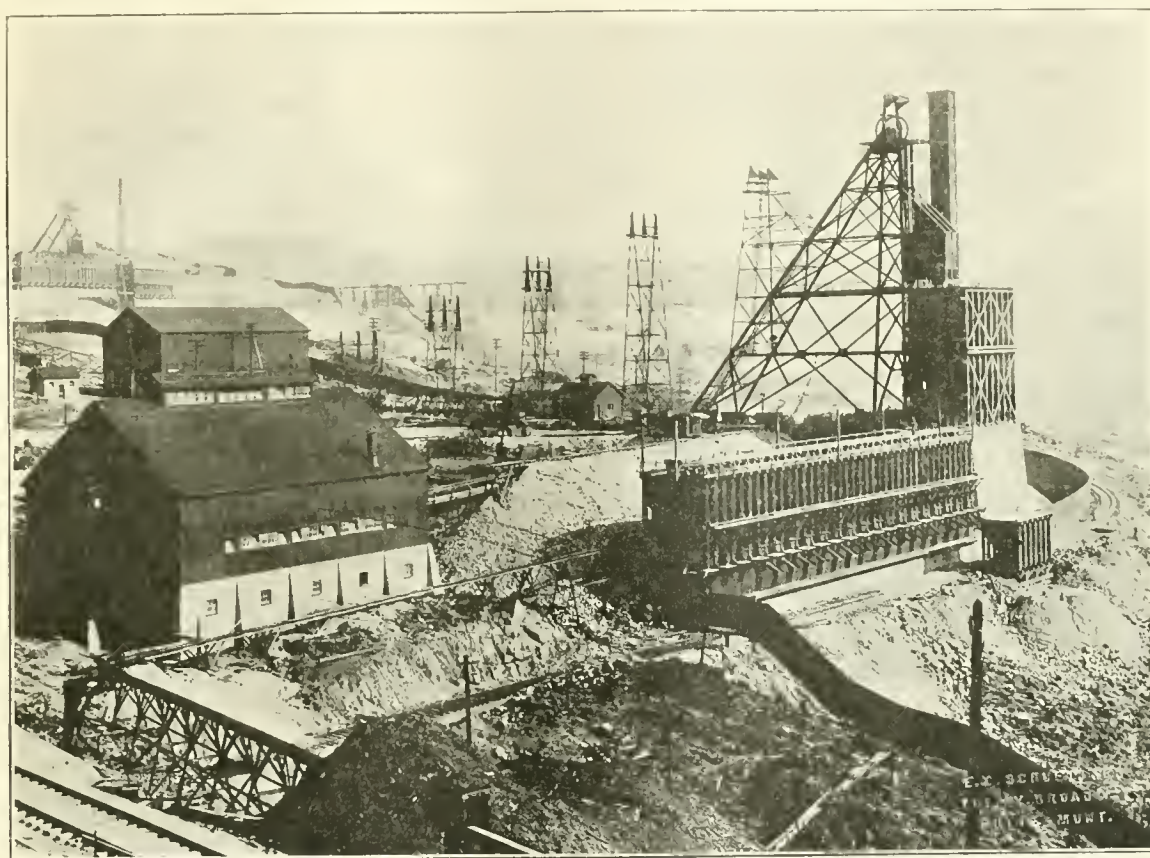
OREGON

Gold Hill—The War Eagle Mining Co., producer of mercury, has closed down its Scott furnace, but is going ahead with development work in the mine. The closing down of

G. D. O'Connor, manager. This company's holdings are situated to the west of the Great Salt Lake, near the Western Pacific railway. In addition to the drifting, two shafts are to be sunk. A five-inch streak of high-grade ore is being followed, assays of which give returns from 30 to 200 oz. silver. A shipment is being prepared for market.

Eureka—The raise started from the face of the Tintic drain-tunnel to the surface, a distance of over 600 ft., has been completed. This will be of assistance in affording better ventilation for the property. The Knight interests are in control of the property; the tunnel is projected for the purpose of draining the south end of the Tintic district.

Shipments from the Tintic district for the week ending May 14 totaled 129 cars, a decrease of 5 from the previous week. The Tintic Standard shipped 43 cars; Chief Con-



The Granite Mountain Shaft of the North Butte Mining Co.

the furnace is not due to the low price of mercury, but to the refractory nature of the ores in the lower levels, which contain arsenic and other refractory minerals. Metallurgical tests are to be made.

The old Bertha gold-quartz mine on Foothills creek has been acquired by Kellogg & Donagan of Gold Hill, who are re-opening the old workings.—Chester Kubli, of Jacksonville, a part owner in the old Kubli gold-quartz mine five miles south of Gold Hill, is re-opening the mine for operations.—Carter & Rawles, who recently acquired the Red Oak gold-quartz mine adjoining the Kubli, are re-opening and developing.

Jacksonville—The Blue Ledge Mining Co. that has been mining copper ore without interruption since the War has closed down. The proposed construction of the \$50,000 electric power-plant has been indefinitely postponed.

UTAH

Arnold—Drifting has been started from the north shaft at the Pennu Copper Mining Co.'s property, according to

solidated, 35; Iron King, 15; Dragon, 12; Iron Blossom, 8; Eagle & Blue Bell, 5; Victoria, 3; Gemini, 2; Colorado, 2; Eureka Bullion, 1; Mammoth, 1; Bowers, 1; Eureka Hill, 1.

The shaft at the Zuma property will be extended from the 500-ft. level to the 1200-ft. level, according to A. C. Nebeker, superintendent. A small amount of work performed by means of winzes below the 500-ft. level has proved the existence of ore as deep as the 900-ft. level, and a recent shipment was taken from this development work.

Milford—About one carload of ore per week is now being shipped from the Gold Crown property near here. The ore averages \$2 in gold, 22 oz. in silver, 0.9% copper, and 18% lead, with an excess of iron. When this property was first opened some years ago, it attracted attention owing to the fact that ore was found close to the surface. Under the management of James Kirk, development operations resulted in opening three feet of ore on the 250-ft. level, shipments from which netted \$46 per ton. At a depth of 400 ft. the ore has been proved for a width of three feet and a length of about 55 ft. G. L. Williams is now in charge.

Park City.—Ore shipments for the week ending May 14 totaled 1545 tons, as against 1112 tons for the week preceding. The Silver King Coalition shipped 734 tons; the Judge allied companies, 636, and the Ontario, 174 tons.

Salt Lake City.—Outstanding features of the Utah Copper Co.'s report for the first quarter of the year 1921 are the improvement in the grade of ore treated, an increase in the percentage of recovery, and a net deficit of \$1,714,317. The net loss from copper production was \$53,616. Miscellaneous income, including payment for precious metals, made the total income for the quarter \$215,715. Loss on government bonds sold being \$305,543, the total net loss for the quarter amounted to \$89,827. Disbursement to stockholders of \$1 per share or a total of \$1,624,190 made the net deficit for the quarter, \$1,714,317. The total quantity of ore milled during the quarter was 1,202,700 dry tons, being 444,300 tons less than the preceding quarter. The average grade of the ore was 1.16% copper and the average extraction was 83.87%, as compared with 1.11% copper and 79.89%, respectively, for the previous quarter. The average cost per net pound of copper produced from concentrates and leaching-plant precipitates was 13.18c., without credit for gold and silver or miscellaneous income. This cost includes all fixed and general charges, but excludes Federal taxes and depreciation. After deducting 1.19c. for gold and silver credits and miscellaneous income the net cost was 11.99c. per pound.

Tooele.—The new mill of the Utah Consolidated Mining Co., near the terminus of the company's tramway from the mines at Bingham, is nearing completion. The results of milling-tests made last year on copper ores showed that a considerable saving could be made by concentration. Seven tons was put into one and a product made on which the smelter has given a favorable contract. Plans were completed, and in July 1920 construction work started on a 1000-ton concentrating plant. The mills situated within a few hundred feet of the International smelter and alongside the company's present aerial tramway, which extends from the mine four miles distant to the smelter. The work on the building and installation of machinery has progressed satisfactorily, although the work has not been rushed, owing to the low price of copper.

There is in sight in the mine \$15,000 tons of copper ore, averaging 1.96% copper, 0.57 oz. silver, and 0.04 oz. gold.

WASHINGTON

Keller.—Richard Marsh, of Spokane, has taken a contract to build and superintend a cyanide plant which the Keller Copper Co. will construct at its property, 12 miles north of here. March will start construction at once. The cyanide plant will handle 20 tons of ore per day; the company already has a mill with a daily capacity of 40 tons.

BRITISH COLUMBIA

Ashcroft.—The Hellsgate Mining Co. has been incorporated here for the purpose of developing the dry-placer deposit discovered recently near Spence's Bridge.

Prince Rupert.—There is anxiety with regard to the reopening of the Dolly Varden mine. The average run of the ore is less than 40 oz. of silver per ton, and, unless a concentrating plant is built it seems possible that the mine will not be worked until there is an improvement in the price of silver.——There is no mining of any description on the Kitsault river and only a few men are employed on the Illiance river. The present indications point to a dull season.

Slocan.—At the Ottawa mine on Springer creek, A. L. McPhee and associates have resumed work on the new concentrator; it will be handling ore within 60 days. As soon as the mill is working the owners will resume development underground.

Trail.—In the first four months of this year the Trail smelter has received for treatment 149,677 tons of ore and concentrates. This is 50,936 tons, or 50%, more than in the first four months of last year. Almost the entire tonnage is now coming from the mines owned by the Consolidated Mining & Smelting Co. of Canada, which owns the smelter. Total receipts for the year, to date, are divided as follows: Company's mines, 147,579; Gold Hill, Tagham, 33; Millie Mack, Burton, 12; Bell, Beaverdell, 16; Horn Silver, Chokpa, 260; Sally, Beaverdell, 33; Sutherland & Thompson, Beaverdell, 7; Black Prince, Slocan City, 57; Blue Bell, Riondel, 114; Gem, Sandon, 11; L. T., Slocum City, 11; Nip and Tuck, Sandon, 6; No. 1 Ainsworth (lessees), 112; Ruth, Sandon, 21; North Star, Kimberley, 111; Paradise, Lake Windermere, 213.

Vancouver.—The Homestake Mining & Development Co. has been organized to take over and operate the Homestake group in the Alice Arm district. The capital of the company is \$500,000 and the consideration for the claims is \$115,000.——The Calcining Process Co. has been formed to manufacture natural and portland cement, and to calcine limestone, gypsum, and magnesite by a new method.

Victoria.—The Western Abrasive Paper Co., of this city, has leased a garnet mine at Wrangel, Alaska, from the Alaska Mining & Manufacturing Co., of Minneapolis. R. J. Frizell, one of the directors of the abrasive company, has left for Wrangle to superintend mining operations.

BURMA

Rangeon.—The New Coal Mining Co., at Lola, which recently commenced the mining of coal, has been taken over by the new Indo-Burma Oil Fields. It is reported that copper has been found in the southern Shan States, and there seems to be no doubt but that large deposits will be uncovered. The New Consolidated Gold Fields had been granted permission to prospect for ores in the district east of Lashio in north-eastern Burma.

JAPAN

Tokyo.—According to a consular report the copper market in Japan continues inactive, and there is no immediate prospect of a revival. Upward of 32,000 tons of copper is now accumulated in Tokyo, Osaka, Kobe, and other principal cities, and the monthly output by various copper-mining companies in Japan amounts to 5000 tons despite the curtailment of working hours since last summer. The Government has been asked to render aid to copper refiners, but under existing conditions it is impossible for the authorities to grant the request. Apprehension is therefore felt that quotations in Japan will show a further decline in the near future.

The exports of Japanese copper declined from 160,429,333 lb. in 1917 to 71,253,333 lb. in 1918, 43,208,000 lb. in 1919, and 23,300,000 lb. in 1920. The refining companies have been endeavoring to export stocks to India and the South Pacific countries, where the metal has been consumed in large quantities in recent years, but there is no immediate prospect of the output being shipped to these countries because of the universal economic depression. During January 3000 tons was shipped to China, while in February the total shipment to that country was only 300 tons. In view of the fact that the price of copper in China is still on the decline, the trade with that country is regarded as being hopeless during the next few months at least. A proposal is therefore advanced to further reduce the output on the part of six large copper-refining companies in order to save the situation and at the same time to resort to dumping on the European market.

MEXICO

Guanacevi (Durango).—Considerable activity continues here. Development work is being done on a number of re-

cently denounced properties and some new applications have been filed. Guillermo Donatlan has taken up a small group to be titled under the name of La Aurora, situated on the Tres Varones mesa adjoining the Doris, Dos Estrellas, and El Aguila mines.—It is still rumored here that Hilario Lozoya has interested American capital for the construction of a smelter here.

Monterrey.—One of the interesting phases of the present mining situation in Mexico is the widespread prospecting that is going on, particularly in mountain localities that are far removed, in some instances, from any actual mining development. There has been a rush of American mining prospectors to Mexico recently, and for the first time in many years the old-time 'grubstake' seeker for gold and silver is traveling through the mountains with his pack-mule. Recently claims were filed on upon the San Rafael ranch, in a remote part of the State of Durango by Andres Arrieta of Topia, a well-known mining man who plans to start development work upon the property soon.

Regular shipments of silver ore will be started from the Guadalupe group of mines, in the Topia district, by Walter C. Minsch and Martiniano Aguirre. Development work is now in progress upon the property, it is stated.

The Mexican National Resources Co. which was recently formed in San Antonio, Texas, has taken over 40 mines in the States of Chihuahua, Sinaloa, Guerrero, Zacatecas, and Oaxaca, which passed from the hands of their owners by forfeiture for non-payment of taxes to the Government. It is stated that these properties are valued at several million dollars. Among the men who are interested in the new company are: W. W. Collier, president of the State National Bank of San Antonio; Harry Landa, manufacturer; Dr. F. J. Combe, president of the Southern Life Insurance Co.; J. E. Jarrett, and William Tracey Page. Dr. George C. Hinton of New York is also interested.

Saltillo (Coahuila).—A group of four claims to be titled under the name of Santa Teresa has been taken up by Felipe Zertuche. The property is situated in the Ferniza district near Saltillo and embraces a well-defined vein of silver-lead ore.—Tobias E. Guzman has filed on the Iturbide group of four mining claims situated in the municipality of Viesca. The property is situated near El Cobre mine in the famous Jimulco copper district.

Torreon (Coahuila).—The Torreon smelter, which blew in the first of this month, continues to operate and is receiving a few small shipments of ore from the nearby districts, although no new contracts are being made. Due to an improved condition of railroad traffic a sufficient supply of fuel is procurable.

Recent reports from Chihuahua are to the effect that some of the mines of Velardeña belonging to the American Smelting & Refining Co. will be operated and the ores shipped to the Chihuahua plant. The smelter is operating.

ONTARIO

Cobalt.—During April the Nipissing mine produced \$142-, 610. A new shaft-house is being erected at shaft 73 where a fire destroyed the former structure.—High-grade ore has been found at a depth of 360 ft. in the Kceley Silver mine. It is too soon to estimate the importance of the find. Arrangements are being made to resume operation on the Cobalt properties of the Mining Corporation of Canada. The mill has been enlarged so as to treat 300 tons of ore daily as compared with a former rate of 200 tons.

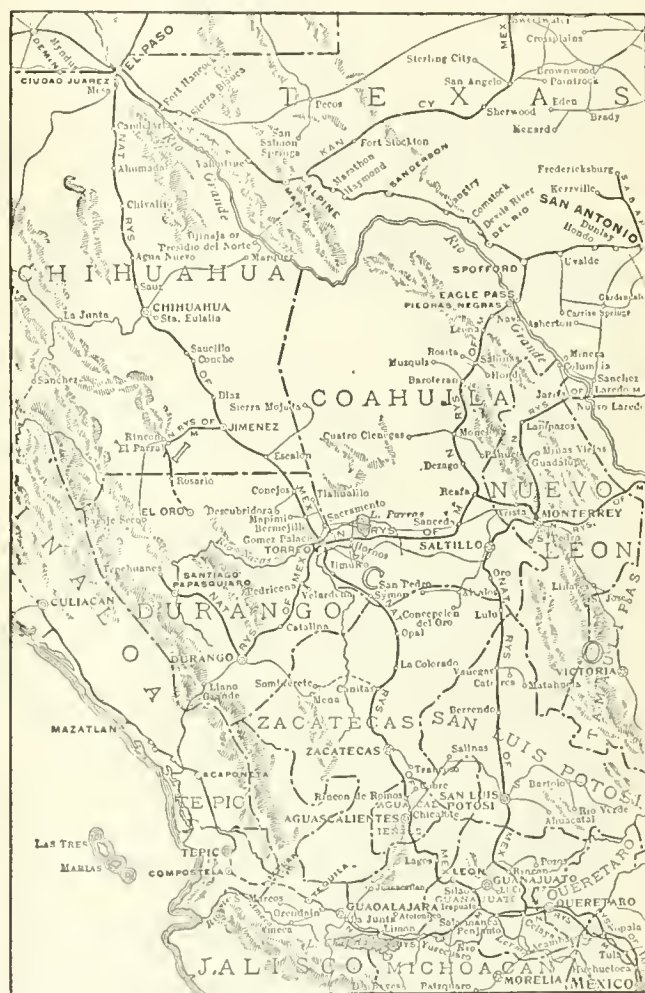
The Oxford-Cobalt property and the Victory Silver Mines have both resumed work. The plant on the Coniagas mine is treating 600 tons daily. This is made up of 300 to 350 tons of ore, 100 to 150 tons of slime, and 100 to 150 tons of sand tailing. The slime is cyanided and the sand is re-ground and treated by oil-flotation.

RUMANIA

The total production of crude-oil in Rumania for March 1921 was approximately 633,591 bbl., against 575,743 in February. Of the total, Steaua Roman produced 122,370, Astra Romana (Royal Dutch Shell) 125,755, and Romana Americana (Standard Oil) 148,715 barrels.

SOUTH AFRICA

Cape Town.—Reports to the effect that important discoveries of platinum have been made recently in the Cala district of South Africa are arousing interest. Platinum ores are not unknown in the Union. They have been traced for several hundred miles along the margin of the Bushveld granite area in the Transvaal, but this locality has not so far been exploited, though samples have been assayed from time to time. Discoveries have also been made in the north Lydenburg district, but unfortunately this part of the coun-



Northern Mexico

try lies over fifty miles from a railway and is almost inaccessible. A reconnaissance has been made, however, by the Railway Department, and in time this district will be opened and the deposits brought within reach of a market. It is probable that richer ore may also exist in other portions of these deposits.

YUKON

Dawson.—Ice in the Yukon river commenced to break up on May 12, accompanied by the usual blowing of whistles and ringing of bells that annually marks the occasion. The Dominion government has extended the privilege to the 'Alaska' and the 'Yukon', United States ships now at White Horse, to carry silver ore awaiting transportation at Mayo Landing.

PERSONAL

The Editor invites members of the profession to send particulars of their work and appointments. The information is interesting to our readers.

C. A. Pohler, of New York, is at Peregrine.

W. H. Landers is at Charleston, West Virginia.

Hugh Rose is on his way from Mexico to London.

Charles W. Goodale is at Marlboro, Massachusetts.

G. A. Collins, of Vancouver, was recently in New York.

George A. Campluis, of Oro Blanco, Arizona, is in London.

W. B. Ingalls is director of the Bureau of Metal Statistics.

Karl F. Klein has moved from Antofagasta, Chile, to New York.

Gerald B. Street, of Wilmington, was in San Francisco recently.

Henry Hanson, of San Francisco, is at Keeler, California, for the summer.

C. L. Ball is general manager for the Huanchaco company, in Bolivia.

A. C. Terrill is professor of mining at the Pei Yang University, Pientsin.

McHenry Mosier has moved from Avalon, California, to Douglas, Arizona.

G. C. Ripley has moved from Great Falls, Montana, to Denver, Colorado.

E. J. Safford has moved from Matehuala, Mexico, to Fresno, California.

Gelasio Caetani has been elected a member of the Italian Chamber of Deputies.

William Wallace Mein, of New York, is at Lake Tahoe, California, for the summer.

John F. Newsom is expected in San Francisco on his return from the Malay States.

W. H. Leonard, of the Denver Rock Drill company, was in San Francisco this week.

F. G. Janney, general superintendent of mills for the Utah Copper Co. at Garfield, is at Chicago.

A. Harms, assayer for the A. S. & R. Co., at Hayden, Arizona, has gone to Rock Island, Illinois.

Alejandro LaCasa, a mining engineer from Madrid, Spain, is visiting the mining districts of Utah.

Frederick H. Minard has transferred his office to the new Liggett Bldg., 47 East 42nd St., New York.

Robert J. Grant has been recommended for the appointment of superintendent of the Denver mint.

W. E. Harrison, who recently resigned as State Inspector of Metal Mines in Utah, is at Pioche, Nevada.

Hallet R. Robbins was in San Francisco on his return from New Mexico. He has gone to New York.

Henry I. Altshuler has gone to Mexico to work with the San Luis Mining Co., at San Dimas, in Durango.

Bradley Stoughton has resigned as Secretary of the American Institute of Mining and Metallurgical Engineers.

Frederick G. Clapp and the Associated Petroleum Engineers have removed their office to 30 Church St., New York.

N. Takahata, mining engineer associated with Furukawa & Co. of Tokyo, has been visiting mining districts in Utah.

E. V. Daveler, mill superintendent for the Butte & Superior Mining Co. at Butte, was at Salt Lake City and Denver recently.

C. B. Neiswender, who was until recently on the staff of

the Inspiration Copper Co., is now in consulting practice at Los Angeles.

J. D. Shilling, general superintendent of the Utah Copper mine at Bingham, is spending a vacation on his ranch in southern California.

W. F. Garland has been elected a member of the board of directors of the Mysore Gold Mining Co. after having served as secretary for twenty years.

R. L. Agassiz, president of the Calumet & Hecla, has been elected president of the Copper Export Association, succeeding John D. Ryan, who declined re-election.

Archie McDonald, formerly connected with the Snowstorm Mining Co., of Idaho, has been appointed manager for the Sterling Mining & Milling Co. at Wallace, Idaho.

C. V. Corless, manager for the Mond Nickel Co., and president of the Canadian Institute of Mining and Metallurgy, recently received the degree of LL.D. at Queens University.

E. C. Lane, of the San Francisco laboratory of the Bureau of Mines, is on a visit to the Bureau Stations at Bartlesville and Pittsburgh. He will visit Washington before returning to San Francisco.

T. Kawaseki, Professor of Mining in the Port Arthur Engineering College, South Manchuria, passed through San Francisco on his way to study mining engineering at the University of Illinois, at Urbana.

Frank R. Wicks has returned from New York to Los Angeles after an absence of four months. He expects to leave again next week for Tiger, Colorado, and will probably remain there some months. He is now general superintendent for the Royal Tiger Mines Company.

Obituary

Arthur L. Pearse died at New York on May 14.

David Goodale, of the firm of Atkins, Kroll & Co., died at Berkeley on May 23. He was born in San Francisco 43 years ago and graduated from the State University in 1900. His untimely passing is deeply regretted by a wide circle of friends.

William Sylvester McCornick, a prominent figure in Western financial, industrial, and mining circles for the past fifty years, died at his home in Salt Lake City on May 18, at the age of 84. He underwent the amputation of his right leg on May 3, and for a time it appeared that he would recover, but the shock of the operation and subsequent complications proved too much for his strength. He was born near Picton, Ontario, on September 14, 1837, and, until he was 21, worked on his father's farm, obtaining an education in the village school. In 1860 he went to California and settled in Marysville, where he engaged in farming for two years. He then went to Comstock, Nevada, and entered the contracting and teaming business. Later he became interested in mining in Nevada. In May 1873 he came to Utah and started a private bank. His money and his executive ability proved the controlling factors in the development of mining properties that became prominent dividend-payers. At the time of his death he was a director and treasurer of the Silver King Coalition Mines Co., and also a director of the American Smelting & Refining Co. He was interested in the Daly West mine at Park City, and in the Centennial-Eureka and Grand Central properties at Eureka, Utah. He married Hannah Keogh, of Belleville, Ontario, on June 16, 1867, and to them were born ten children. He was active in business up to the time of his death. In his death, Utah loses one of its foremost citizens, and Salt Lake City business circles one of its ablest, most honored, and highly esteemed members.

THE METAL MARKET



METAL PRICES

San Francisco, May 24

Aluminum-dust, cents per pound.....	75
Antimony, cents per pound.....	7.50
Copper, electrolytic, cents per pound.....	13.00—13.50
Lead, pig, cents per pound.....	5.25—6.25
Platinum, pure, per ounce.....	\$75
Platinum, 10% iridium, per ounce.....	\$105
Quicksilver, per flask of 75 lb.....	\$50
Spelter, cents per pound.....	7.50
Zinc-dust, cents per pound.....	9.00—9.50

EASTERN METAL MARKET

(By wire from New York)

May 23.—Copper is more active and higher. Lead is quiet but firm. Zinc is inactive but steady.

SILVER

Below are given official or ticker quotations for silver in the open market as distinguished from the fixed price obtainable for metal produced, smelted, and refined exclusively within the United States. Under the terms of the Pittman Act such silver will be purchased by the United States Mint at \$1 per ounce, subject to certain small charges which vary slightly but amount to approximately three-eighths of one cent. The equivalent of dollar silver (1000 fine) in British currency is 46.65 pence per ounce (925 fine), calculated at the normal rate of exchange.

Date	New York cents	London pence	Average week ending Cents	Pence
May 17.....	59.62	33.75	Apr. 11.....	58.00 33.54
" 18.....	59.12	33.50	" 18.....	60.18 34.83
" 19.....	58.75	33.25	" 25.....	60.22 34.77
" 20.....	58.37	33.12	May 2.....	60.68 34.70
" 21.....	58.62	33.25	" 9.....	61.58 35.08
" 22 Sunday.....			" 16.....	60.41 34.42
" 23.....	59.12	33.87	" 23.....	58.93 33.46

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.	141.12	132.77	65.95	July	106.36	92.04	....
Feb.	101.12	131.27	59.55	Aug.	111.35	96.23	....
Mch.	101.12	125.70	56.08	Sept.	113.92	93.66	....
Apr.	101.12	119.56	59.33	Oct.	119.10	83.48	....
May	107.23	102.69	....	Nov.	127.57	77.73	....
June	110.50	90.84	....	Dec.	131.92	64.78	....

COPPER

Prices of electrolytic, in cents per pound.

Date	Average week ending
May 17.....	12.75
" 18.....	12.75
" 19.....	12.87
" 20.....	13.00
" 21.....	13.00
" 22 Sunday.....	
" 23.....	13.00

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.	20.43	19.25	12.94	July	20.82	19.00	....
Feb.	17.34	19.05	12.84	Aug.	22.51	19.00	....
Mch.	15.05	18.49	12.20	Sept.	22.10	18.75	....
Apr.	15.23	19.23	12.50	Oct.	21.66	16.53	....
May	15.91	19.05	....	Nov.	20.45	14.63	....
June	17.53	19.00	....	Dec.	18.55	13.18	....

LEAD

Lead is quoted in cents per pound, New York delivery.

Date	Average week ending
May 17.....	5.12
" 18.....	5.10
" 19.....	5.10
" 20.....	5.10
" 21.....	5.10
" 22 Sunday.....	
" 23.....	5.10

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.	5.60	8.65	4.96	July	5.53	8.63	....
Feb.	5.13	8.88	4.54	Aug.	5.78	9.03	....
Mch.	5.24	9.22	4.06	Sept.	6.02	8.08	....
Apr.	5.05	8.78	4.32	Oct.	6.40	7.28	....
May	5.04	8.55	....	Nov.	6.76	6.37	....
June	5.32	8.43	....	Dec.	7.12	4.76	....

TIN

Prices in New York, in cents per pound.

	1919	1920	1921		1919	1920	1921
Jan.	71.50	62.74	35.94	July	70.11	49.29	....
Feb.	72.44	59.87	32.16	Aug.	62.20	47.60	....
Mch.	72.50	61.92	28.87	Sept.	55.79	44.43	....
Apr.	72.50	62.17	30.36	Oct.	54.82	40.47	....
May	72.50	54.99	....	Nov.	54.17	36.97	....
June	71.83	48.33	....	Dec.	54.94	34.12	....

ZINC

Zinc is quoted as spelter, standard Western brands, New York delivery, in cents per pound.

Date	Average week ending
May 17.....	5.35
" 18.....	5.35
" 19.....	5.35
" 20.....	5.35
" 21.....	5.35
" 22 Sunday.....	
" 23.....	5.35

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.	7.44	9.56	5.86	July	7.78	8.18	....
Feb.	6.71	9.15	5.34	Aug.	7.81	8.31	....
Mch.	6.53	8.93	5.19	Sept.	7.57	7.84	....
Apr.	6.49	8.76	5.33	Oct.	7.82	7.50	....
May	6.43	8.07	....	Nov.	8.12	6.78	....
June	6.91	7.92	....	Dec.	8.09	6.03	....

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, according to quantity. Prices, in dollars per flask of 75 pounds.

Date	May
Apr. 26.....	50.00
May 3.....	50.00

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.	103.75	89.00	50.00	July	100.00	88.00	....
Feb.	90.00	81.00	48.75	Aug.	103.00	85.00	....
Mch.	72.80	87.00	45.88	Sept.	102.60	75.00	....
Apr.	73.12	100.00	46.00	Oct.	86.00	71.00	....
May	84.80	87.00	....	Nov.	78.00	56.00	....
June	94.40	85.00	....	Dec.	95.00	52.50	....

SECRETARY MELLON'S TAX PROGRAM

A correspondent in 'The Annalist' says: The letter sent to the Senate Finance Committee and House Ways and Means Committee by Secretary Mellon gives a fairly comprehensive idea of the program which the majority of the administration leaders hope to carry out in revising the revenue law. Mr. Mellon would reduce the upper brackets of the surtaxes on personal incomes so that in 1921 the combined normal and surtax shall not exceed 40%, and in the years thereafter shall not exceed about 33%. This means that the combined tax for 1921 shall include the normal tax of 8% and the surtax of 32%, the surtax now paid on that part of the income, which is above \$66,000, and does not exceed \$68,000. In other words, persons having incomes of more than \$68,000 would pay what amounted to a tax of 40% on their total income. Under the present law the surtax, in addition to the normal tax, rises gradually to a peak of 65%, which is collectable on that part of the income designated as "\$1,000,000 or more". The actual peak in the present law, taking into consideration the normal tax of 8% as well as the surtax of 65%, is 73%. In the years after 1921, under the Mellon plan, the normal 8% tax and the present surtax rates up to 25% would be collected.

It is pretty generally admitted here among students of the tax and revenue problem that the upper brackets of the surtaxes—those above 32%—are relatively unproductive. Mr. Mellon's statement that they would yield not more than \$100,000,000 per year came as something of a surprise to many, but that is what the statistics show. It is probable that Mr. Mellon's statement that a reduction of the surtax rate would bring about a turnover of securities which would yield a larger amount of revenue to the Government will stand the acid test. Such a revision at the same time may give comfort to the possessors of great fortunes, but from the practical viewpoint of the amount of revenue collected the Government might be better off.

There would seem to be little or no doubt that both branches of Congress will agree to wiping out the excess-profits taxes. In its place Mr. Mellon suggests a flat additional tax on corporate incomes which would avoid determination of invested capital. He is convinced that a tax of this character at the rate of 5%, combined with the repeal of the \$2000 exemption applicable to corporations, would yield about \$400,000,000. The outlook is that some such plan will be brought about.

There is bound to be a fight, however, for the repeal of the tax on transportation, which Mr. Mellon says must be retained because of the large yield to the Government. Another fight is almost certain to centre on propositions which have been made for a more general repeal of taxes which hit the pocketbook of the masses, such as the tax on theatre admissions and sporting goods, the retention of which Mr. Mellon holds to be essential.

While it seems to be the opinion of Mr. Mellon that the national budget cannot be kept under \$1,000,000,000 for 1921 or 1922 the general tenor of his recommendations have brought a reassuring note into the situation. It is noted that he has made no provision for the payment of soldiers' bonuses in his recommendations.

MONEY AND EXCHANGE

Foreign quotations on May 24 are as follows:	
Sterling, dollars: Cable	3.96%
" Demand	3.97 1/2
Francs, cents: Cable	8.62
" Demand	8.64
Lire, cents: Demand	5.50
Marks, cents	1.70

Eastern Metal Market

New York, May 18

There has been no great change in any of the markets. Buying is not heavy and prices of one or two metals have developed some softness.

Foreign buying of copper continues with a slight improvement in domestic demand. Prices are higher.

Buying of tin is moderate and the market is firm.

Demand for lead has eased off and values are lower.

No improvement has developed in the zinc market which continues lifeless and softer.

Antimony is unchanged and inactive.

IRON AND STEEL

The prospect of quietness in the summer months is more influential in the steel market, says 'The Iron Age'. Producers now are quite unanimous in seeing only a few weeks ahead a slackening in the activities of automobile works which have been the chief basis of hope recently. Steel works are running at 30 to 35% of capacity, on the average, and some important companies put the amount of new business at about one-third normal bookings. The Steel Corporation, which had a poor average of new business in March and April, particularly in March, when its price reductions were impending, has found its orders since May 1 running nearly 30% more than the average for the two preceding months. This is better than most independent companies are doing and is due in part to current export business.

The railroads are even less disposed than they were earlier in the year to receive deliveries on orders placed with steel mills. Five important Western lines have laid no rails this year, despite the fact that a good many of their 1921 rails have been delivered. One line has had 60,000 tons delivered; this it has put in storage.

COPPER

An interesting birds-eye view of the copper market is about as follows, in the opinion of one large seller: Present rate of production is down to about 40,000,000 lb. per month while deliveries into consumption, foreign and domestic, will probably average 100,000,000 lb. per month this year. This should in the long run make the copper position strong. As European buying improves, and it should from now on, domestic buying will pick up.

Prices are advancing and the market tone is better and firmer. Electrolytic copper for May-June delivery can probably not be bought for less than 13c., delivered. This is the firm price of all leading producers and others seem to be up to this level or higher. Sales to foreign buyers predominate though domestic demand, or at least inquiries, are better. It is figured that sales for foreign consumption have totaled 10,000,000 lb. in the last two or three weeks. Another seller states that demand appears to have been in waves recently, March having been mostly foreign; April, domestic; and May now foreign again. We quote the electrolytic market at 13c., delivered, or 12.75c., New York, for May-June delivery. Lake copper is also higher at 13c., New York, or 13.25c., delivered, for the same positions.

An interesting statement is that German producers of copper products can sell their products in France cheaper than can French producers, after paying transportation and import charges, and the same price for American copper that French buyers do.

TIN

The market while quiet is strong, particularly abroad. There has been very little buying by consumers, but there has been the usual moderate volume of purchasing by deal-

ers. Even London dealers have been in this market, due to higher prices prevailing there; this demand has been even larger than the combined consumers' and dealers' domestic buying. The business done has involved May-June-July arrivals largely; the largest volume was on last Thursday when total sales amounted to about 850 tons. On other days, the offerings were less plentiful. Prices in London are higher than a week ago by £7 to £8 per ton, spot standard yesterday having been quoted at £181, future standard at £182 15s., and spot Straits at £187. Spot Straits tin at New York has hovered around 32 to 33c., the quotation yesterday having been 33.25c., New York. Arrivals thus far this month have amounted to 605 tons with a total of 2150 tons reported afloat.

LEAD

No developments of any marked importance have been reported. The market is quiet and prices are easier. Demand has fallen off and inquiries are not so numerous. The leading interest is evidently taking some of the business at its regular quotation of 5c., New York and St. Louis, and the remainder is going to independents at around 4.95c., St. Louis, or 5.12½c., New York, which we quote as the market. Part at least of the 10,000 tons of Spanish and foreign lead that has reached this market has been held in storage, it is reported.

ZINC

Still lifeless and without feature is the report on this market. Prime Western for early delivery is obtainable as low as 4.85c., St. Louis, or 5.35c., New York, which we quote as the market. Many producers will not sell under 5c., St. Louis, but one or two will part with a carload or so at the lower prices, demand being confined to small amounts. Light sales have been made at these low prices.

ANTIMONY

Conditions are unchanged with the market quiet at 5.25c., New York, duty paid, for wholesale lots for early delivery.

ALUMINUM

The leading producer is quoting virgin metal, 98 to 99% pure, in wholesale lots for early delivery at 28c. f.o.b. plant, while the same grade from other sources, mostly foreign, is obtainable at a range varying between 23 and 23.50c. per pound, New York.

ORES

Tungsten: Demand is only fair and sellers' ideas of prices are relatively high, due to tariff uncertainties. Chinese ore is quoted at about \$3 to \$3.50 per unit, with high-grade ore correspondingly higher.

Ferro-tungsten is quoted at 58c. per pound of contained tungsten in guaranteed lump form.

Molybdenum: The market is nominal at 55 to 60c. per pound of MoS₂ in regular concentrate.

Manganese: No business in high-grade ore is reported and quotations are nominal at 22.50c. per unit, seaboard.

Manganese-Iron Alloys: There is almost no demand for ferro-manganese which has declined to \$80, delivered, for the American alloy, with the British product available at \$75, seaboard. **Spiegeleisen**, 20%, has sold at \$30, furnace. About 250 tons has been sold and about 250 tons is before the market. The prevailing quotation is \$30 to \$32, furnace.

Ferro-silicon, 50%, can be bought at \$80, delivered, in almost any quantity for delivery this year.



T. A. RICKARD, Editor

THE prophet Micah's forecast of the days when men would "beat their swords into plowshares and their spears into pruning hooks" has been more than fulfilled in these latter days by the use made of floating mines. Many of these instruments of assassination have been found on the shore of the Gulf of Finland, and refugees from Kronstadt have been fed by the American Red Cross at Terioki. The finding and the feeding are connected by the fact that the mines, after their charges have been removed and their fittings detached, have been converted into soup-pots.

'BARRON'S', the new financial paper, speaking of organized and unorganized labor, says that "The average layman will perhaps not readily grasp the incalculable increase in 'job spirit', workmanlike emulation, fellow-feeling, and man-to-man co-operation that the 'open shop' system engenders among workers. Talk to a non-union man and you almost invariably feel that here is one who has the good of family and country at heart, rather than unthinking obedience to demagogues or unfounded distrust of employers". There is much to be said in favor of the 'open shop', despite Judge Gary's truculent advocacy.

FINANCIAL participation is one of the greatest incentives to effort and to the practice of economy. The Electrolytic Zinc Company, of Hobart, Tasmania, recently made a proposal of a novel kind to its employees. Wages and salaries are to remain at the present level, but weekly deductions are to be made before payment, on a sliding scale, and ranging from 10% to 7½% of the amount earned. The deductions are to be placed to the credit of a trust-fund, to be converted into shares of the company, which will be held in the names of the workmen. Amounts below a certain minimum will be paid in cash. The proposal has been approved by a majority of the works-committee, representing all employees.

DIRECT production of articles of commercial utility in the electrolytic cells of a copper-recovery plant would greatly reduce the cost to the ultimate consumer. The work of melting and fabrication would be avoided, to say nothing of the cost of handling between the various copper-selling agencies and middlemen, all of whom exact their bit of profit, which, in the aggregate, makes

the pound of shaped copper so expensive that a cheaper and less efficient substitute is often sought. A method of obtaining a large variety of copper articles, by direct deposition from the leach solution, has been proposed; it is claimed that a smooth and satisfactory surface is practicable. Tests are to be made, we understand, at the Ajo plant of the New Cornelia Copper Company, and the results will be anticipated with interest.

IN a Texan newspaper we find an item concerning a mine that lies "between a paughfrey and a mica schist formation". This sounds almost as promising as the lode between cyanide and hootchite. Moreover, "gockets of sulphide or copper glance" have been discovered; these interesting accretions being "a secondary enrichment" containing 40 to 60% copper, and 100 to 1000 ounces of silver, "which is characteristic of this mine". Then it has a high-class character, without doubt. Indeed "Mr. O. Martin of Mexico City and Mr. Haywoodson of Helena, Montana, have pronounced this the largest deposit of copper, silver, and gold that has been developed in this country". The dimensions are not stated, but the deposit is one of unusual scientific interest. A gocket in paughfrey is unique.

THE importance of discipline in mine management was emphasized by Sir Lionel Phillips at the recent annual meeting of the Transvaal Chamber of Mines. Although it may be possible and proper to appoint committees whose purpose it is to consult with the mine manager, to discuss with him matters where men's lives, their manner of living, their working hours are concerned, nevertheless there must be someone who can assert authority in matters connected with the ordinary operation of the mine. If the mines were in the hands of the working population, they would find it necessary to have either one man or a small committee of men with absolute authority, whose commands had to be obeyed. The desire of every man to rise in the world and to better his position is a logical one; but the welfare of a man, according to Sir Lionel, can only be advanced by the efforts of that individual himself. If the workers would only take that truism to heart, and if each gave to the industry the best of his effort during the reasonable hours of his employment, a considerable reduction in the cost

of production of gold would result. As Mr. Arthur J. Balfour said, "It is a very easy thing for a government to make rich men poor; the great problem for every government is to make poor men rich". Men cannot better themselves except through their own strong efforts. If mine managers should be met with demands that are considered as unjustifiable, these should be resisted, in the interests of the working population, the industry, and the country.

PROMOTION of a better knowledge of Spanish in the United States and of English in Latin America might be furthered, in the opinion of the Minister of Guatemala, who spoke at Washington recently, by the organization of a society or league to promote the reduction of language barriers between the Spanish- and English-speaking peoples of this continent. The teaching of English is compulsory in some Latin-American countries; the extension of the use of Spanish as an item of practical education in the United States would facilitate the plan, proposed by Mr. Bianchi, to arrange for the interchange of clerks between the different countries. A real knowledge of the other fellow can only be obtained by personal contact. The thoughts and aspirations of our neighbors to the south would be all the clearer to us if, as a nation, we could understand what they have to say.

INADEQUATE remuneration of engineers is illustrated by a list of average incomes, compiled by the secretary to the class of 1910 of Cornell University. The list is headed by the bankers and brokers, whose average income is \$11,040; these are followed by 14 classes, including veterinarians, salesmen, insurance 'financiers', advertising men, purchasing agents, farmers, and builders; then come the engineers, with an average salary of \$3,724—next but last on the list and before the teachers, who earn an average of \$3,137 annually. Scientists and research men are probably included among the engineers, and this may account, to some extent, for the low average. The figures suggest one of two things: either some of the Cornell graduates are calling themselves engineers when they are not in the professional class, or the devotees to this branch of human endeavor are, like the teachers, being poorly paid for their services. It is interesting to note that the number of engineers in the list is more than twice as much as may be found in any other of the classified professions of occupations that are enumerated. Over-crowding may have something to do with the existing low rate of pay. The subject is one that merits discussion.

INSECURITY of tenure was the keynote of a speech made recently by Mr. Whiting Williams, the author of 'What's on the Worker's Mind', to the members of the Commonwealth Club of this city. Mr. Williams, who was formerly the assistant to the president of Oberlin college, submerged his identity and went to work for ten months last year as a common laborer in mines, mills, and railroad shops both here and in Great Britain. He was

impressed by the far-reaching effects that lack of a job or fear of losing the job have upon the average worker's mental attitude; according to him, it accounts for the spread of the doctrine of reduced production, of diminished labor. When Mr. Williams set to work at one place, carrying bricks, a fellow workman came up and enquired: "What da hell! Where da fire?" Without some sense of security in the matter of being able to maintain himself and his family, the laborer loses his spirit, and then falls an easy prey to the preachers of bolshevism; the Reds and the I. W. W. obtain their recruits almost entirely from the ranks of the unemployed. The worker needs more than his daily bread; he needs self-respect; his inarticulate prayer is "Give me this day my daily job"; and he wants a job on the morrow, too. Social and industrial conditions in Great Britain are in a parlous state, according to Mr. Williams, who found more unrest and bolshevism there in seven days than he had observed in the United States in as many months. He compared the conditions at Middlesbrough, the Pittsburgh of Great Britain, where employment is regular and where the workers are properly housed, with the conditions in Glasgow, where work is irregular, where social conditions in a certain stratum of society are unmentionable, and where Mr. Williams found that in some parts of the city, a man or a woman who did not stagger with real or assumed drunkenness on a Saturday night would be looked upon with suspicion. Irregular jobs make irregular workmen; irregular workmen make irregular citizens. Mr. Williams' sincerity was evident, his impressions had been formed as the result of an actual experience that gives them weight; he has drawn attention to a phase of the relations between employer and employed to which more attention might well be paid.

COMBINATIONS are liable to result in an unfair restraint of trade, hence the legislation against this form of business in this country. In Chile, an association of producers has been successful in raising the market price of nitrate to such a point that sales have declined to a level that is causing some concern to the Government, which obtains a large proportion of its income from the export tax on nitrate. President Alessandri is now asking his congress to approve a plan to nationalize the sale of nitrate. This plan, if consummated, will kill the present export tax; the profit from the transactions will be divided between the Government and the producers. However unwelcome such interference, the producers have only themselves to blame. The reduction in the price, which would automatically follow the adoption of such a plan, would benefit all concerned; the maintenance of the high-price level has been one of the reasons why little attempt has been made to improve the percentage of extraction or to reduce the cost of production. In spite of small-scale operation and inefficient beneficiation, big dividends have been paid to the stockholders in nitrate companies, a circumstance that has been due largely to the impoverishment of large areas of nitrate-bearing ground by the selective mining of high-grade caliche only. The idea has been to grab

profits while the grabbing was good. The Government is now waking up to the economic waste involved, a waste that, to the producers who are scared with the bogey of cheap synthetic nitrate, is of no moment. President Alessandri's initial action in the matter is doubtless only a preliminary to drastic governmental interference; it should do much toward removing a serious restriction against the sale of a product that is in urgent demand at the present time. It will lead to a consideration of whether the Government should or should not concern itself more directly with the methods adopted in working the deposit, in an effort to minimize the wastage of a national asset.

NOT enough notice has been taken of the decision made recently in the case of the Rochester clothing industry. It appears that the wages of 7000 workers were affected by this decision, which was the result of an arbitration placed in the hands of a Dr. Leiserson. He authorized the transfer of all the workers in the Rochester men's-clothing industry from a day's-pay to a piece-work basis. Those who worked by the week were making 20% to 25% less than the piece-workers, whereas the cost of labor per garment was greater under the week-work than under the piece-work system. Dr. Leiserson held that the economic motive to increase earnings would be a decisive factor in decreasing the unit-cost, and would prove more advantageous to the manufacturer as well as to the worker, than a reduction in wages without an added incentive to production. This, of course, is entirely in accord with the experience of those who have charge of mines in which the contract system enables the men to earn more while at the same time decreasing the cost per ton or per foot, whatever the unit of measurement. The one reason why the contract system fails, as it has in many mines, is because it is applied unfairly to the workers. In these, as in all economic engagements, a spirit of fair play is fundamental.

WE sympathize with the young college graduates who were declared to be "grossly ignorant" by Mr. Edison because they were unable to answer satisfactorily a catechism of 77 questions propounded, by the so-called wizard of East Orange, to recent applicants for positions in his laboratories. Obviously the intent of the questions was to determine the character and extent of the candidate's reading, and the receptiveness and retentiveness of his mind for general information. However, many of the questions concern trivial historical and geographical facts, easily ascertainable in two minutes by reference to any encyclopedia, but with which few men attempt to clutter their memories. Another kind of question deals with semi-technical information that is entirely well known to specialists in particular industries; but to expect all, or nearly all, of these queries to be answered off-hand by a young man is hardly reasonable. Some of the questions are not open to precise answer, for example: "In what State are located our chief copper mines?" Most mining engineers would say Arizona; Mr. Edison had

Montana in mind. He, doubtless, had all the information contemplated in this questionnaire at his finger-ends; however, we should like to prepare a set of queries, different in detail but identical in general character and submit them to him. With all due respect for Mr. Edison's unusual attainments, we believe he would have to exert himself to make a perfect record; and, we venture to surmise, he might re-appraise the abilities of some of the recent aspirants for modest jobs in the Edison organization. During the War young officers were subjected to sundry peculiar mental tests designed to determine the alertness of their minds, and the quickness, keenness, and accuracy of their thinking. The men who passed these examinations with exceptional success almost invariably made good officers. The ability to store away a lot of miscellaneous information in the files of one's memory and to refer promptly to isolated facts when required is an asset; but the mind that is too busy with memorizing has little time left for thinking.

A CORRESPONDENT in the 'South African Mining & Engineering Journal', reminiscing with reference to a prospector to whom he was able to extend a kindness that was remembered in later years, says: "He was very ill and knew that his end was near. He called me aside and told me that in return for what I had done he wished to tell me something important—that in a certain place that he described minutely he had found rich reef gold. When he discovered the reef he had no money to peg and hold, so he covered up his work and remained silent. A rush took place over another field in that locality and his reef was covered by the pegging. The ground was held for 25 years, off and on, by people who, he knew, were not likely to give him much recompense for his information. He was never one of the lucky prospectors, and preferred to go to the end very poor rather than to disclose his find to the Johannesburg financial 'sharks', as he called them." Such a sentiment, we would add, is found not only in South Africa, it is in evidence elsewhere and in many other branches of endeavor. Prospectors are human: they have a natural repugnance to giving up everything and getting practically nothing in return; many become soured by the inconsiderate attitude of the promoter with whom they do business. The correspondent to whom we have referred makes a pertinent and timely suggestion toward aiding in the opening up of new mining districts and to encourage the prospector and small-mine owner. He suggests the formation of Government banks, for the purpose of giving financial assistance to those in need, with a limit of from £3000 to £5000 advance on any one property. These advances would be the first charge on operating income, and would be granted only if sufficient gold were developed; the money would be issued solely for the purpose of financing the erection of a treatment plant. The district that contains the contented prospector and the prosperous small-mine owner is likely to have a future. The plan, if adopted, would help to encourage the search for new goldfields.

Ventilation and Miners' Phthisis

In a recent issue we drew attention to the factor of humidity in the question of mortality or sickness among mine-workers; in the report from which we quoted it was mentioned that the death-rate among employees who were working in a humid atmosphere was much higher than among those who were working in a dry atmosphere, the humidity in the former case being the result of efforts to allay the dust that arose from grinding and polishing operations. We came to the conclusion that, although the development of the tubercle bacillus is hastened by environment in a humid atmosphere, in most cases it is considered that the good done by allaying the dust in a mine more than counterbalances the ill effects of increased humidity. The time has come, however, when it should be recognized that the allaying of dust underground is not the ultima Thule of preventive measures against disease in general and tuberculosis in particular. In many mines insufficient attention has been paid to the subject of good ventilation, and this is the reason why tuberculosis, when once developed among miners, progresses into the 'galloping' stage so frequently. In a paper read recently before the Chemical, Metallurgical and Mining Society of South Africa, Mr. C. J. Gray, the chief Inspector of Mines for the Johannesburg district, emphasizes this fact. According to him, the reason for the apparent apathy on the part of South African mine-owners is generally monetary. The purchase and maintenance of fans involves considerable expense. For many years, on the Rand, spraying was optional; even now fan ventilation is optional, and the distribution of air is haphazard. A manager who tried to better conditions underground would find his costs increasing; head offices would naturally compare the expenses with those on mines where no such work was being done. The desire for improvement would thus be stifled at its source; apparently legislation is necessary. Lack of ventilation, according to Mr. Gray, is at the root of the trouble; it is largely responsible for the conditions of ill-health among underground workers. The adoption of such improvements as sprays and atomizers, wrote another observer in 1906, merely indicates that the evil is being played with. Water is only a palliative; ventilation is the cure by which a clean bill of health can be secured. We read in the preliminary report of an investigation that was made on the subject of miners' consumption in the mines of Butte, Montana, and recently issued by the Bureau of Mines, that "in most of the working places examined in Butte the temperature was well above 70°F., little or no movement of the air was perceptible, and the humidity approached saturation. Comparatively little work in such places causes body temperature quickly to mount from 98°F. (normal) to 103° or higher—that is, to fever temperature. The immediate effect of such conditions is greatly to decrease the working ability of the men. It is the impression of the authors of this report that in the places visited the time spent in actual work during an eight-hour shift was not in excess of four to five hours, and was probably much less. An adequate

movement of the air, even if it did not lower the temperature, would greatly increase the efficiency of the men". We are inclined to query the general statement as regards rise in body temperature under such conditions; nevertheless the report deserves consideration. The two signatories to the report make a number of suggestions, particularly as to how effective ventilation can be secured; they recommend a more extended use of doors, of fireproof canvas and brattice, and of regulators; on haulage roads a type of door should be used that can be relied upon to close automatically and that will allow a minimum leakage of air; all mines should be ventilated by means of fans.

It is significant that although the investigations were concluded in 1919, the report, a pamphlet of only 19 pages, did not appear until recently. This indicates, apparently, the congestion of printing work at the Government offices in Washington. It is regrettable that reports of value, containing definite recommendations for the amelioration of unsatisfactory conditions, cannot be printed and distributed prior to technical reports on unimportant matters and of only local interest. Between the time of the investigation by the Bureau of Mines officials and the issuance of the report, Mr. A. S. Richardson, the ventilation engineer for the Anaconda Copper Mining Company, published an account, in the 'Anode', of ventilation in the mines at Butte; he detailed the factors that control or influence the conditions that have prevailed in the past and will prevail in the future; and he outlined the steps that are being taken by the company to ensure, as far as is possible, the satisfactory ventilation of, and the reduction of temperature in, the underground workings. From this account we learn that, in the Butte mines, the rock temperature may be as high as 104°F.; the heat underground is also partly due to the 'oxidation' of the mine timber, which is used in large quantity. The problem has been considered in all its details. It was found that resistance in the shafts, due to the open framing of timbers, retarded the flow of the air. The shafts have been lined with cement slabs and the faces of the timbers have been covered. The volume of air circulating, per man, amounts to more than 400 cubic feet per minute; 600 cubic feet per man per minute will be obtained when all the equipment proposed is in operation. It is pointed out that the laws governing the ventilation of both the bituminous and anthracite coalfields of Pennsylvania call for the circulation of 200 cubic feet of air per minute. Difficulty has been experienced at Butte in maintaining air-tight the ventilation doors and bulkheads. Lower-level ventilation is to be ensured by 'booster' fans, 200 of which will be used in the company's mines when they are all in operation. In short, it seems that the Anaconda company is taking steps to remedy the conditions mentioned in the Bureau of Mines report; it has always been the policy of the company to take such action; it is 'good business' to better conditions that are unsatisfactory. The importance of the subject will be realized when it is mentioned that of 1018 miners

at Butte that were examined between 1916 and 1918, no less than 432, or 42.4%, were found to be suffering from phthisis. Continued attention to the problems of dust-allaying and ventilation, coupled with the enforcement of a restriction that tuberculous men should not be permitted to work underground, will do much to reduce infection and to prevent the spread of the disease.

The Railroad Problem

The railroads may be likened to a very sick man. As to this there is general agreement; the fact is also accepted that, in the public interest, the sick man must not only be kept alive but must be restored to normal health. However, as to the exact cause of the illness and the best remedy to be applied, opinions differ widely. The Senate Committee on Interstate Commerce, of which Senator Cummins is chairman, recently started an investigation to determine how the railroads got into their present predicament and how it might be possible for the Government to assist them. In opening the inquiry Senator Cummins stated that the net operating income for the year ending March 1, 1921, was only \$2,578,922, as compared with \$787,610,435 in 1913. It is obvious that 2½ millions does not represent a reasonable return on the capital invested in railroad property. Statistics presented by Mr. Julius Kruttschnitt, Chairman of the Board of the Southern Pacific company, show that the volume of traffic during 1920 established a record never before equalled. The freight movement amounted to nearly 450 billion ton-miles; the passenger traffic totaled 46 billion miles; and the freight-rates averaged 1.104c. per mile, as compared with 0.55c. in 1913 and 0.974c. in 1919. The gross operating income for the year ended March 1, 1921, was \$6,175,962,000. But on the other side of the ledger is found an entry of \$5,825,388,510 as direct operating expense, to which must be added taxes and miscellaneous charges before calculating the net income of about 2½ millions. During recent months unquestionably there has been marked industrial stagnation; production has fallen off and railroad traffic has decreased. However, for the period under consideration, the statistics cited show that the volume of traffic was at the peak, that the rates were the highest since the Interstate Commerce Commission was created, but that in spite of these favorable factors there was practically no profit. Senator Cummins defined the situation clearly when he said: "The problem before us is to ascertain whether the six billion dollars received as operating revenue . . . was wisely, economically, and effectively expended." The only alternative to a reduction in operating cost would be an increase in freight-rates, which appears to be inadvisable even to the railroad managers. Those who have goods to ship contend that business is being strangled by the high rates and that a reduction is imperative. The railroad executives maintain that the existing rates have had little to do with the present business depression: they contend that many commodities would not be shipped even though the railroads offered to move them free of charge. Although this is literally true at the moment

with respect to certain raw materials for which there is no immediate market, the general principle that an excessive cost of transportation will hamper industry seems unassailable. At the same time the executives of the railroad companies do not deny that sundry adjustments downward are advisable; doubtless they see the advantage of making a voluntary reduction to stimulate particular classes of traffic in preference to facing a horizontal decrease by order of the Interstate Commerce Commission. The recent decision to reduce the trans-continental rates by 20% in order to compete with the cost of all-water shipments by way of the Panama Canal is an illustration.

If, as seems certain, no great increase in revenue over that of 1920 can be expected, the obvious solution of the problem lies in reducing expenses. Mr. Kruttschnitt concedes that the trouble with the railroads is excessive operating expenditures, of which an "abnormal amount" is represented by the cost of labor. Had the increases awarded by the Railroad Labor Board in the middle of 1920 been in effect during the entire year the total disbursement for labor would have been 3980 million dollars; actually it was 3742 million, as against approximately 1700 million in 1917. He illustrates the evils of the re-classification, of the rulings in jurisdictional disputes among the crafts, and of the regulations put into effect in 1918 with respect to overtime. He enumerates dozens of instances in which absurd claims for wages have been allowed under the provisions of the national agreement made during the period of Federal control. However, neither these unjust rulings as to wage-payments nor the huge total represented in wages has any bearing on the establishment of a fair wage-scale. The railroad managers, nevertheless, maintain that a reduction in wages is warranted, first, because it is necessary in order to cut expenses; second, because it is justified by the reduced cost of living; and third, because it is possible to hire men in the open market for much less than the rates provided in the national agreement. The managers declare that they have no quarrel with their employees, but that their aim is to promote "a friendliness and co-operation which will result in work at satisfactory wages for the largest possible number of men, and in an efficient and economical service to the public". To this attitude no one can take exception.

The employees, on the other hand, particularly the union brotherhoods, declare, through Mr. W. Jett Lanek, a self-styled economist, that expenses can be reduced sufficiently, to assure the necessary excess of earnings over the cost of operation, by efficient and economical administration without any alteration in the wage-scale. They allege that the railroad companies purchase fuel, material, supplies, and equipment from concerns owned by the railroad interests, at exorbitant prices, the money finally coming back into the hands of the controlling stockholders in the form of profit from the vending concerns. This charge is called "absurdly untrue" by the railroad executives. The old argument based on presumed over-capitalization of the companies is ad-

vanced to show that they are endeavoring to earn a return on fictitious capital never actually invested. No one denies that years ago a great deal of 'water' found its way into the stocks of some of the railroads, but, taken as a whole, the railroad systems of the country are not greatly overcapitalized, as is indicated clearly by the data already obtained by the engineers of the Commerce Commission in their survey for a physical valuation. It is also contended that increased rentals for dwellings have more than offset any decrease in the cost of other necessities. In any event, the Labor Board has announced that wages for common labor will be reduced by from 10 to 15%, the new rates to become effective on July 1 next; this will be followed no doubt by further readjustments for all classes of employees, based on the decision that the cost of living has actually decreased during the last year. According to the U. S. Bureau of Labor this decrease amounts to slightly more than 30%.

Mr. Kruttschnitt suggests other remedies which he said were "easily applied and productive of great economies". He discloses the existence of two grievances; one is against the motor-truck, the other against the Panama canal. His attitude is typically that of the 'railroad' man; as is natural, he can see only the railroad side of the question; he does not realize that, if certain kinds of traffic can be handled more efficiently and economically by motor-truck or by cargo-ship, it is not in the interest of the public for the Government to make laws for the purpose of artificially diverting such traffic to the railroads. At the same time the railroads offer definite advantages over any other method of transportation, their welfare is vital to the industrial prosperity of the country, and they must be maintained for efficient service. Mr. Daniel Willard, president of the Baltimore & Ohio railroad, declares that private ownership cannot last if the operating results of 1920 are not improved upon in measurable degree. The alternative is Government ownership or at least Government operation. Like every other branch of industry the railroads are suffering from the general depression. This, however, is but temporary, and when the reaction comes private management will be put on its final trial. The Interstate Commerce Commission, while it fully appreciates the gravity of the situation, can remedy it only by increasing rates, and increased rates do not necessarily mean increased revenue. Every increase in the cost of transportation by rail obviously widens the field for successful competition by motor-trucks and ships; it has a sure tendency to decrease the margin of profit on commodities in general, and thereby to decrease traffic. The Labor Board has indicated already its policy to give what assistance it can reasonably and justly; Congress is willing to help, but can do little; the outcome appears to depend finally upon the railroads themselves and their administrators. They can no longer shift the blame for everything bad onto the shoulders of the erstwhile Director General of Railroads. Although the experience of the two and a half years preceeding March of 1920 is not reassuring, the fact remains that Government operation with unified control

has distinct advantages that offset to some extent its proved shortcomings. It remains for the railroad executives to show the public that they can run their business profitably in fair competition with other forms of transportation, and without resort to the old abuse of discrimination against one community or one commodity because the 'traffic might bear it'. Apparently the taxpayers would rather support the railroad under Government control, with all its faults, than support them indirectly by guaranteeing 'standard' returns to private owners. If the officials succeed in operating their roads effectively and efficiently, private ownership is likely to survive; otherwise the remedy is plain.

Education for Miners

Educational facilities, in the various mining schools of this country, have increased to an undesirable extent, according to Mr. H. H. Knox, whose comments on the subject appear in the current bulletin of the Mining & Metallurgical Society of America. The acquirement of a higher education has been so easy that many a good mechanic has been spoiled in the making of a poor engineer. The principle underlying such higher education, in Mr. Knox's judgment, compares unfavorably with what is considered desirable in some other countries. The university here is but the extension of the high-school. "The pupil enters, remains, and finally departs, through the gateways of examination; his sole aim is a degree. In short, the university is essentially a mechanism for attaching diplomas to young men; and it is indeed fortunate if, after the accomplishment of this act, the jaded faculty has any time or spirit left for original work and contributions to learning." Mr. Knox sees a need, in our university system, for the provision of educational facilities for extra-graduate students, regardless of age, station, or education, who may desire instruction in any subject whatsoever, and whose time available for such work may vary from four days to four years. The student should be the only judge as to his own needs. If such arrangements could be made, little alarm need be felt that the privilege would be abused. As Mr. Knox says, "the hunger for knowledge is not yet a public menace; there is small danger of an unwieldy 'bread' line". The suggestion is worthy of consideration. The well educated man, we would affirm, owes his mental equilibrium to his acquisitiveness, not because, by temperament or training, he has been merely receptive. Originality and initiative are the best indices as to whether education is 'taking'. An altruistic desire for enlightenment may come long after college life has passed, long after a degree has been gained for proficiency in the memorizing of facts and theories. If our universities could help in the encouragement of this most important branch of higher education they would be performing a notable service to themselves, as well as to a part of the community deserving encouragement in the consummation of a natural desire to climb to a position where scientific research may be undertaken.



The Colorado School of Mines

The Editor:

Sir—My attention has been called to a letter from D. H. Fairchild published by you in your issue of March 26, under the title 'The Colorado School of Mines'. As an alumnus of the school, I feel it my duty to correct, if possible, some of the misstatements it contains and if it is not too late I humbly beg the privilege of doing so at this time. My delay in sending in this communication was occasioned by an indecision in my own mind as to which would benefit the school the most, an answer to your correspondent's letter or simply ignore it. The School has suffered unjustly from too much talk in the public press from those who when pinned down to the facts have to 'pass the buck' and say that some one else told them. At the present time the School is in better shape than it ever has been since I first became acquainted with it when I entered in 1908.

The statement contained in the second paragraph of the published letter that Mr. Lee, who acted as attorney for the president, trustees, and faculty, at the request of some of the alumni and friends of the School, classed President Alderson with Washington and Lincoln is, of course, ridiculous. What he did was to draw the attention of the committee to the fact that it all too frequently happens in American public life that honest, energetic, faithful, and successful public servants are made the subject of vicious and unfounded attacks. He called attention to the recent experience of Charles M. Schwab, who served as a 'dollar-a-year man', and in like manner to the libelous statements that were given wide circulation with reference to Washington, Lincoln, Grant, Cleveland, McKinley, and Roosevelt, taking merely the familiar instances that are, or should be, known to all men of general information.

It is perfectly true that he characterized the evidence as "hearsay", and what was not hearsay was of such trivial nature as not to warrant consideration by any committee of responsible men. You will note in reading the letter from your correspondent that while it is stated that "considerable evidence was submitted that was not at all favorable to the defence and was of such a nature that the committee cannot dismiss it as hearsay", such evidence is not mentioned in that letter, which proceeds to discuss the experimental mill at Golden and to give the impression that that plant was of no practical use. Two of the members of the Legislative Committee were practical mining men of large experience. They heard all of the evidence and made personal examination of the

mill, and came to the following conclusion, which will be found in their report to the State Legislature:

"It has been indicated in the testimony that this experimental plant was useless. This opinion, your committee must utterly disregard. Your committee thinks it is useful and that it can be made of very great use to both the School of Mines and the mining interests of this State, if sufficient funds are provided to complete the plant in accordance with the original plans prepared and submitted, supplemented by changes which may be necessary to make at this time, in order to bring said plant to up-to-date practices and in full conformity to the needs of the School."

Your correspondent did not include in his communication any reference to the testimony of an engineer representing one of the largest corporations in the country, who has been for many months past and is at the present time making constant use of this experimental mill in ore-testing, and who testified that it could be used practically and efficiently.

Your readers may or may not have noticed the significance of the statement contained in the letter that "a bale of telegrams from various mining companies and other sources was submitted". These telegrams were statements that the graduates of the Colorado School of Mines were competent and efficient, and adequately educated men, whose work was satisfactory to the companies employing them. They came from the biggest mining and engineering concerns in the country. This would seem to me to be the final test of an institution of this nature.

Your correspondent is correct in saying that Mr. Lee, in his closing argument, criticized Mr. Lunt and the writer of that letter for their excessive interest in the promotion of the attack upon the Colorado School of Mines. Mr. Lunt is Commissioner of Mines to the State of Colorado, and admitted on the witness stand that he had absolutely no personal knowledge of the conditions as to which he was appearing to testify; yet without any personal knowledge he was willing to repeat unfounded slander. Mr. Fairchild's attention to the affairs of the School is sincerely appreciated, but we marvel that a graduate of the Rolla School of Mines should be so willing to condemn the Colorado School of Mines and its experimental plant. Then, later, without waiting for the report of the committee, to burst into print, this time not only criticizing the School but going farther and criticizing the method that the School used in defending itself before the Legislative Committee. This profound attention "passeth all understanding", until it is known that

Mr. Fairchild shares an office with one of the professors who, upon the re-instatement of Dr. Alderson as president, sought the court to restrain the trustees from appointing him.

The gentlemen mentioned in his letter, Messrs. Taylor and Wells, both admitted upon the witness-stand that they had no personal knowledge with regard to conditions at the School of Mines. Notwithstanding this fact, Mr. Taylor volunteered the statement that the recent graduates of the School were not competent men, but admitted upon cross-examination that he had no acquaintance with more than from five to ten men during several years last past, and plainly demonstrated that he had no means of knowledge as to whether these men whose reputations he was willing to blast were properly qualified or not. Such was the general character of practically all the testimony offered before this Legislative Committee, and such only is the basis to the libels that have been circulated with reference to the School.

The testimony on this hearing was taken by a court reporter and has been transcribed, and is available for anyone who seeks to investigate its nature. The report of the Committee cleared the School, its president, trustees, and faculty of all of the so-called charges made against the institution and its governing officers. The report of that committee you apparently have received. The report was made only after a painstaking investigation consuming several weeks of time, in which every conceivable type of evidence offered on behalf of those opposing the management of the School was heard with almost incomprehensible patience, and in the course of which investigation the Committee visited the School, inspected the plant, and interviewed the students and faculty. Your correspondent mentioned that, with the faculty and trustees present, the students were willing to testify that everything was in good shape. To quote him, we read: "This testimony might have been given under duress." He fails to mention that when the Committee visited the School they met the student body without a member of the faculty, trustees, or the president present. At that time the Committee invited any individual student or students that had any complaints to meet them either publicly or privately. This invitation to register a complaint was unanimously rejected.

In your opinion, ought this investigation and report put an end to the publication and circulation of the irresponsible reports of men having no knowledge of the situation to which they refer in their correspondence? The reputation of the Colorado School of Mines has been excellent and has been world-wide. It seems to me that no fair-minded man who would take the trouble to investigate or to familiarize himself with the record of the investigation just concluded could credit further disparaging reports with regard to the institution to anything other than malice or personal spite. To the disinterested such a conclusion would seem inevitable.

This letter is written with the hope that before publishing further reports with reference to conditions at the Colorado School of Mines you will make investigation as

to their basis and fact, and that you will give it the same publicity given to the criticism referred to.

Denver, May 12.

S. POWER WARREN.

[We are, of course, entirely willing to publish this letter, as the writer ought to know. We did avail ourselves of the opportunity to investigate the conditions obtaining at Golden, as Mr. Warren ought to have known before suggesting that we knew nothing about the matter. The present writer was at Golden soon after the rumpus in 1917 and made careful enquiries at Golden and at Denver. The chief trouble with the Colorado School of Mines has been due to the fact that the alumni have not been in agreement on the chief issues involved in the long-drawn wrangle. Many of them dislike Dr. Alderson intensely, probably just as many support him cordially. We gave a fair summary of the Legislative Committee's report in our issue of April 23; it is not our fault if Mr. Warren is unaware of this. It seems to us that if a committee of the State legislature reports approvingly of Dr. Alderson's administration, there is nothing more to be said by those who are not citizens of Colorado. Mr. Warren may rest assured that we shall avoid the subject henceforth; it has ceased to be interesting.—EDITOR.]

Prospecting

The Editor:

Sir—I have read your very interesting address on prospecting delivered at Portland, and your invitation to the prospector to tell what he thinks of the future of prospecting. The following is in reply to your invitation.

It is hard to say what the future of prospecting will be, but whatever it is it will depend a whole lot on what we think it ought to be. I will state in this letter what I think it ought to be, and what I think ought to be done about it.

Your address calls to mind a number of points that I have been turning over in my mind for some time. At one place in your address you state, "What is wanting today is the link between the prospector and big capital, namely, the local storekeeper and merchant who used to back the man in the hills by grubstaking him, by giving him credit for supplies, and even by putting up cash when necessary". There is no doubt but what the local storekeeper has in the past lent valuable assistance to the prospector; but there is another side to this question. The local merchant, as a rule, is not an unbiased party in the promotion of the mining industry in his locality. As a merchant, he should be interested in steering capital against the best properties in the district; but as an owner of mining claims himself he is interested in steering capital against his own properties, which may not, by any means, be the best in the district. These interests conflict. The merchant, being in closer contact with capital, puts the regular prospector at a disadvantage. It frequently happens, as many a prospector can tell you, that a mining man coming to look at a prospector's property is sidetracked, simply because he happens to meet

some local merchant or a local mining man at the club or at some hotel.

Elsewhere in your address you state, "the local wise men are likely to be better judges of a local prospect, if they have no financial interest in it". An unbiased local wise man is a rare bird, indeed. If he does not happen to have an interest in the property that is to be examined, he generally has an interest in some other property. This gives him an interest in 'knocking', to a man who has money to invest, all other properties but his own. The knocking of the local wise men is no uncommon thing; it is constantly being done, to the great detriment of every mining community. What every mining community needs, as much as anything else, is disinterested merchants and local wise men. If every merchant had no other interest, except his own business, he would be interested in seeing that every prospector got a square deal; he would try to direct the investor to the best prospects in the district.

Speaking of future mineral production, I don't believe that paying mineral is as scarce as many seem to think. It is probably true that most of the high-grade stuff has been worked out, but this is only a drop in the bucket to what remains. The first mines to be worked in nearly every mining district are the richest and the poorest. The richest because they will pay big with very little trouble, and the poorest because the wild-catter can make more money by promoting a poor property; he can get the poor property for less. There generally remain a lot of properties of average grade that can, with good management, be made to pay. The average-grade properties are more plentiful than the high-grade, and have far more mineral in them. Besides this, there is a lot of undiscovered mineral in every district.

What is needed to work these average-grade properties, as they should be worked, is a thorough prospection of all veins in a district, in order that the best may be found and worked on. That, and more good managers. The purpose of prospecting, other than finding mineral, if carried out rightly, is to eliminate the poor prospects—unpromising prospects—with the idea of working the best. The enormous amount of labor wasted unnecessarily on working wild-cats and through general ignorance is sickening, when one thinks of the enormous amount of good it would do if directed properly. Bad mining laws are also responsible for a lot of unnecessary work being done. Take, as an instance, location and assessment work. For the most part it is useless; it is labor wasted; it gets no forwarder. No more work should be done on any prospect than to determine its comparative value, so eliminations can be made. Or take the location laws, as another instance, which, by causing many different veins to be owned by many different people, induces a lot of work to be done on worthless claims, and a lot of work to be done before it is needed. The location laws cause all mineral to be placed under many different ownerships; the work is scattered, much being done on worthless claims, instead of being concentrated on the best claims where some good can be done. What we want

to do is to work the best claims first, and to work the best always. This can't be done by the way things are arranged at present.

You speak of the romance of prospecting. We are very apt, in talking about prospecting as we see it today, to see only one side of it, the bright side, and not see the tragedies of it. We are very apt to see only the great rewards that a few have gained, but to ignore the many it has practically ruined. For every one it has rewarded greatly I can show you a hundred it has treated shabbily. In this, as with gambling, we hear a great deal about the big winnings, but very little of the harm it has done. The trouble is, the prospector's pay-days, though they may be big, are too few and far between. A few owning the very richest claims, if they find them early in their lives, get their reward early, early enough to do them some good; but the vast majority have to wait from 10 to 40 years before they get theirs. And it may be a small reward at that. When they do, it is generally too late to do them much good. Their age and the life they have led has destroyed their capacity for enjoying it. Ten thousand dollars would do them just as much good as a million. A billion dollars wouldn't pay them for what they have lost; nothing would. Our wants are so distributed that we have to live as we go along, if we are to get much out of life; and our rewards, for that reason, must be distributed accordingly. What is needed is a system of distributing risks and rewards, whereby a prospector can get some of his reward as he goes along, instead of waiting until some time in the distant future, when he has no great need of it.

You state, "public opinion in the United States is opposed to the payment of direct monetary subsidies to prospectors". So am I, and, what is more, I am opposed to subsidies from any other source. I believe prospecting should stand on its own pins, just as every other business should; I believe that prospecting should be supported by the proceeds of prospecting, from the sales of prospects, or at least by the mining industry, instead of being supported by merchants who must add what they have lost to the cost of what they sell. As things are conducted at present no track can be kept of what things actually cost to produce. Let the prospector do the prospecting, the miner do the mining, and the merchant the merchandizing. By such an arrangement prospecting, and all other business, would gain immensely by being conducted by those who understood the business. Such an arrangement would also cut the wild-catter off at the pockets. The wild-catter preys on the ignorance of the people.

You state that "risk is the essence of mining, risk with a chance of more than adequate compensation". Risk is a large element in any business, but in mining it is probably larger than in any other. Good mining consists in reducing this risk by a better knowledge of mining and risking the rest, which risk may be distributed and shared by many, by means of better organization. The element of risk in mining will always, in all probability, be very large, no matter how scientific we get;

mining will always need adventurous spirits to carry it on.

Risk in any business may be distributed in two ways: (1) By dividing the business into stages. Mining is naturally divided into three stages, the prospective stage, the speculative stage, and the productive stage. These different stages, if conducted by distinct groups, distribute the risk, and make the pay-day come oftener than if one group carried the whole operation through all the different stages, which is not often done. It can only be done with a rich property, and by big capital. Also, this division of labor, which makes for expert knowledge and labor, would lessen the risk. (2) The risk is distributed by causing it to be shared by many, through larger organizations. In these two ways, the evils of too big a pay-day (it is an evil to have more at one time than is really needed) and too long a pay-day will be avoided. When we get right down to the bottom of things, isn't the biggest problem in life the distribution of the inequalities of things—the burdens—over time and space—absorb the shock from bumps and smooth them out so things will ride a little easier and safer.

Speaking of distributing risk, by dividing mining into stages: It often happens, for various reasons, principally financial, that one man or a company can't even carry one of these stages through to a successful conclusion; they have to drop the work before they are through. Then someone else comes along, takes up the work where the other left off, finds something, and reaps the reward and the credit. This often happens in prospecting, and just as often in developing a mine. This injustice, which, probably, isn't anybody's fault, must be attributed to faulty organization. A fine example of this is found in the development of the Little Daisy or U. V. X. J. J. Fisher, the first manager of the Little Daisy, and the people he represented, did the pioneer work. To them a great deal of credit is due, which they have never received. They revealed a mineral condition that any mining man would take as a first-class guide in further exploration. Fisher without a doubt suffered greater disappointment than anyone ever connected with the Daisy. His death was to a great extent due to the ups and downs of its development.

All the obstacles to good mining mentioned in the foregoing are due to faulty organization. Many individuals and many small organizations working in as many narrow fields can't possibly carry on mining, or any other business, without a great deal of risk and loss, or without a great deal of inconvenience and suffering, and, in many cases, without lasting injury. Mining cannot be carried on in a scientific and business-like manner, or with comparatively little inconvenience and suffering, except by big organizations with big fields to work in—the bigger the better.

The ideal prospecting condition would be to treat all mineral as if it was in one vast group of mining claims, owned by one big prospecting company. Of course, it is to be understood, it is not thought that such an ideal arrangement can possibly be realized very soon. It is

only advanced as being a goal to drive for, something to be consummated in the distant future: as something to remind us that, whatever our prospecting troubles, most of them are due to the lack of these ideal conditions.

The following is an outline of a plan of prospecting developed while I was working for a big mining company in Central Africa. It, undoubtedly, can be much improved, but it will serve to show how, by some such method, much more easily and more quickly really essential information can be gained where an extensive region is prospected by one big company. The plan here described applies to conditions as they exist in Central Africa.

Where a large territory is to be prospected by a few men in a limited time, a selection of the best ground should be made before or at the expiration of that time, and a part, possibly, exploited during that time. It is necessary to adopt some method of prospecting whereby the best ground may be found in the shortest possible time. We have conditions something like these on a mining concession. I can describe a method that, I think, will accomplish the desired results.

To have a clear understanding of this method it is necessary first to state some facts concerning the distribution of gold. (1) The most gold is found on or near bedrock. This is due to the force of gravity. (2) The coarsest gold is found along the shortest path water can take in passing down-stream. The pieces decrease in size as the path gets longer or passes to one side. Where the richest ground will be found depends on the size of pieces composing the bulk of the gold. If composed principally of fine gold, the best may be found considerably one side of the straight path. This rule will, of course, be modified by the structure of the bedrock; but on the whole it is safe to say that the most gold will be found near the shortest path. The shortest path has the steepest grade and the swiftest water; the curved path has less grade and the slowest water. The coarse gold being carried down by the swifter water above will be deposited a little to one side of the straight path when it enters the slower water of the more curved path, leaving only the finer gold to be deposited along the curve. On the other hand, when the stream takes the straight path the water flows faster, taking with it the coarse gold, which may reach bedrock or be deposited in the gravel at or near the swiftest part. The coarse gold is found at or near the straight path because the swift water is the only water capable of moving the coarse gold. The swift water of the straight path also helps free the gravel of fine sand, leaving the coarse gravel, which may be taken as an indication of the best ground. The coarsest gravel is along the straight path for the same reasons the coarse gold is there. The prospecting maps show that, as a rule, the richest ground is found near the straight path.

(3) The richest and poorest ground, respectively, are found in the small branches or heads of streams, because they may be entirely in goldbearing and non-goldbearing rocks. There is less chance of having rich and poor

gravels mixed, as is the case in the lower parts of streams. Also the swift water, due to steep grades in small branches, frees the gravel of the finer stuff. (4) Quartz gravel, with which the gold is usually associated, is lowered in value when mixed with other gravel, such as diorite, diabase, schist, particularly schist impregnated with iron and hematite. As much as 95% of the gravel is quartz in these African streams. This is due, no doubt, to the fact that, being in a region of abundant rainfall and vegetation, and with a tropical climate, all minerals except quartz and quartzite are easily decomposed. (5) The lower parts of a stream system are usually not as rich as the upper parts. This is due to a more thorough distribution of the gold throughout the whole deposit, on account of its fineness, and to the mixture of the poor and rich gravel of the upper parts. Gold in the large streams of a district, though not in paying quantities, may be taken as good indications of the possibilities of the small streams flowing into it. (6) As a rule the best placer is not found in or near the valleys, nor are the veins so well exposed as in the mountains.

Any method of prospection must take advantage of these facts of gold distribution in order to accomplish the best results. Prospection should proceed as follows: First, it should begin in the mountains. Second, the streams in the mountains should be prospected by cutting across them in many places. A number of holes at, above, and below the point of intersection of the route will give a fair idea of the value of the ground, and the possibilities of the upper parts of the stream. A better idea of the value of the ground in the lower parts of a stream can be gained with a few holes, on account of the better distribution of the fine gold, than can be gained in the upper parts, in which the distribution of the gold is usually irregular. This prospection will indicate what streams have the greatest possibilities, also, some idea of its accessibility, food supplies, and the routes would be gained. Third, selecting the stream which is thought to have the best possibilities, accessibility and food, follow it up, taking samples at different points, also surveying it. Where a stream is found entering the main stream, follow it up a short distance, taking a few samples. This prospection would show at what places camps should be located so the streams could be prospected more in detail. Fourth, follow up the streams running into the main stream, taking samples at different points. Follow them to their very head if they prove at all promising, as float indicating the presence of a vein may be found, of which samples should be taken. It is unnecessary to survey any small stream unless it proves promising, which can be done later when the stream is prospected more in detail. This can be done without loss of labor. It is not necessary to know anything of an unpromising stream other than to show on the map where it enters the main stream. A large stream entering the main stream should be surveyed in order to indicate promising and unpromising small streams entering it. Fifth, select the best of these small streams with an idea of finding if any of them would pay to exploit. A few samples would in-

dicate if any were poor, rich, or doubtful. Further sampling should be confined to the best ground, for if the best is not payable it would be a waste of labor to sample the poorer.

Sampling should not be carried any further than to enable comparisons to be drawn. For example, in the N'Gayn-Nepoka region sampling should not be carried any further than to make a comparison with Babeyen; if Babeyen is unpayable, it would be a waste of labor to do much sampling on streams that don't compare with it. Any extensive sampling of streams poorer than Babeyen must be suspended until Babeyen is shown to be payable. In most of the streams a very few holes is sufficient to draw a comparison with Babeyen, as they are decidedly poorer. As the value of the ground approaches that of Babeyen more holes are necessary. If decidedly richer a few holes is sufficient. In the first preliminaries (every prospection is more or less preliminary or more or less detail) where more or less of a qualitative test is desirable (every sampling is more or less qualitative, or more or less quantitative) it is sufficient to take a few pans off the bottom, selecting the most promising looking ground to sample, if that is possible. Such is often indicated by coarse gravel. Ground containing much other gravel than quartz may be passed with a few holes, if poor, for it is likely its pooriness is due to this gravel, which contributes nothing to the value of the gravel. Much heavy iron causes a great loss in saving the gold. Gravel with much iron may also be skipped with a few holes, if it is poor. Gravel of the large streams may be passed with a few holes, as the richer material is liable to be found in the branches. A hole is the best part of a stream, or what is considered the best part, and is all right where a qualitative test is all that is wanted. Small streams with little gravel can be passed with little sampling, on account of the great cost of working small deposits. If very rich, a few holes will show it.

It is admitted that by this method of prospecting there is a possibility of missing valuable ground; but in no sense is the sampling to be considered as final. There is always a chance, after the completion of this sifting process, of sampling the more promising of the unsampled streams until the expiration of the time allowed for prospecting. In other places where no time limit is set by law, the time is set by a prospector's pocket-book, and it is always desirable to find something payable as soon as possible. By a method that samples, alike, all streams as they are reached—a catch-all sort of a method—there is a greater chance of missing valuable ground than by the method mentioned above, on account of considerably more work having to be done by a few men in a large territory; there is also a chance of leaving unsampled a great amount of country at the expiration of the time limit. Prospection is essentially a process of elimination. The object in a preliminary prospection is not to find and sample every stream and ledge, but to find sufficient data to enable the company to make selections and to be able to outline the work of more detail prospection, so more prospectors can be put to work with the idea of

quickly finding the best. This same prospecting method—a process of elimination—can be applied to lode prospecting. I notice Mr. Charles H. White describes some such method in your issue of April 30.

Prescott, Arizona, May 10.

WM. CROCKER.

The Mackenzie River Basin

The Editor:

Sir—Shortly after it originally was published, in the 'Mining and Scientific Press' of October 4, 1919, I reviewed Memoir 108, No. 92, Geological Series, entitled 'The Mackenzie River Basin', by Charles Camsell and Wyatt Malcolm. In the summer of last year oil was struck 45 miles below Fort Norman, and, as this official publication was the only one bearing on the district that had been issued by the Canadian Geological Survey, there was so great a demand for it that it soon became exhausted. The report has been revised; an account of the discovery by the Imperial Oil Co. is included, together with the result of a fractional distillation of the oil that has been made in the laboratory of the Mines Branch of the Department of Mines, at Ottawa, and the report is now available to those interested in the district.

A good deal of cold water has been thrown on the discovery by the technical press, particularly south of the international boundary, with a view, no doubt, of preventing a heedless rush of prospectors to the district, and also, to some extent, of counteracting the effervescence that a large part of the western Canadian daily press has exhibited. That a heedless rush of prospectors to this district would be little short of a calamity cannot be gainsaid, but, on the other hand, a careful perusal of the memoir under consideration can hardly leave the thoughtful reader with any doubt as to the great possibility, one might almost say probability, of the existence of an oil-field of considerable magnitude in this remote region. Let me quote: "It has been known for a century that oil seepages issue from the Devonian rocks of this area. It remained for the boring near Norman to demonstrate the occurrence of an oil-pool in these rocks. There is a vast area that may prove favorable prospecting ground. Rocks of the Devonian system are of wide distribution and stretch from near the mouth of the Mackenzie river south to beyond lake Athabaska (a distance of more than 1000 miles). They are overlain in places by rocks of Cretaceous and Tertiary age and pass beneath the Cretaceous sediments on Peace and Athabaska rivers. . . . In many places the Devonian strata are highly bituminous in character, and several petroleum springs are known. The upper beds penetrated by boring at Vermilion Chutes are impregnated with bitumen, and strata exposed near La Butte, on the Slave river, and in several places around the western arm of Great Slave lake are highly bituminous. Bitumen occurs in limestone at the Ramparts, in some of the dark argillaceous shales exposed at the water's edge along Grand View, and in the shales in a small plateau lying a short distance east of the Mackenzie, 15 miles below Grand View. The shales in this plateau are reddened in places by the com-

bustion of the bituminous matter. Fifteen miles further down the river evenly-bedded, highly bituminous, black, Devonian shales occur". Of these R. G. McConnell says: "The laminae, when freshly separated, are moistened on the surface by an oily liquid, and burn when thrown into a fire. Patches of red shales, marking the sites of former fires, alternate with the dark varieties. The shales are exposed on the right bank for some miles, or almost as far as old Fort Good Hope". There is more in the same vein and other observers are quoted, but the foregoing is sufficient to show the character of the rocks for hundreds of miles within the neighborhood of the discovery. The possibility of finding a commercial oilfield in such a district would seem to be rosy.

The prospector, however, that contemplates visiting this district, and the investor that is prepared to stake him, must weigh other considerations besides the discovery of oil. First and foremost among the disadvantages is the inaccessibility of the district. Should a commercial oilfield be discovered it will take considerable time and an immense amount of money to construct transportation facilities whereby the oil may be brought to market. Neither the prospector nor the investor should delude himself with the idea, either, that it is possible to stake claims for speculative purposes while others, better backed financially, solve the transportation problems. The Dominion government has provided against such a contingency. It insists that an adequate drilling outfit must be placed on the property within two years of a permit being granted, drilling to a depth of 500 ft. must be done during the third year, and an aggregate depth of at least 2000 ft. during the fourth year, and in the event of non-fulfilment of these conditions the permit lapses automatically. Considerable pressure has been brought to bear on the Government to induce it to soften the harshness of these regulations, considering the inaccessibility of the region, and, while it is likely that they will be tempered to some extent, it is probable that they will remain sufficiently strict to bar the blanketing of the district with claims staked purely for speculative purposes. The transportation of a drilling outfit and supplies into this district is as difficult as the transportation of oil from it, consequently no one that is not well backed financially and that is not prepared to wait to receive the reward for labor and money expended should entertain prospecting for oil in the Mackenzie River basin. On the other hand, it seems to me that those that have weighed carefully these considerations and are willing to wait for their reward have as great an opportunity to succeed in the far North as in any other unproved field. The coming year will see a considerable amount of activity and a considerable amount of drilling in the district, and it is likely that within the next six months we shall know a great deal more about the possibilities than we do now. At the same time, of course, it will be the ones that go in now, always provided they are properly backed, that will reap the largest rewards, if rewards there be.

Victoria, B. C., May 14.

F. H. MASON.



ANTOFAGASTA, CHILE. THE PORT TOWN FOR CHUQUICAMATA

The Chuquicamata Enterprise—I

By A. W. Allen

Chile, perhaps the most progressive of South American nations, can boast the largest known copper deposit in the world, at Chuquicamata, in the Province of Antofagasta, in Lat. $22^{\circ}17'$ south, and Long. $68^{\circ}55'$ west. The port of Antofagasta was, previous to the War of the Pacific, 1879-1881, Bolivia's outlet to the sea. The overwhelming defeat of both Bolivia and Peru in that conflict resulted in a re-arrangement of a large portion of South America: Bolivia lost her seaport and was pushed back into the mountains; Peru lost the immensely valuable nitrate region that lies between the coast and the Andes, as well as the buffer provinces of Tacna and Arica. Chile became the paramount power on the west coast of South America.

The mining camp of Chuquicamata is reached by rail from Antofagasta by means of the Antofagasta & Bolivia railroad; the nearest station is at Calama, a small town about six miles from the copper deposit, and on the main line between the port and the city of La Paz, in Bolivia. The Chile Exploration company's property is situated near the main Pacific range of the Andes and at an elevation above sea-level of about 10,000 ft. So far as the atmosphere is concerned, the climate is delightful, although the variation in temperature is great; the principal drawbacks are the dust in and near the settlement, and the general aridity of the district. Rain is rare, but dews are heavy. Chuquicamata lies about 85 miles from

the Pacific, as the crow flies, 70 miles from the Bolivian border, and about 160 miles from Antofagasta.

As compared with the great majority of South American towns of the same size, Antofagasta pleases the foreigner by its cleanliness, its neatness, and its atmosphere of modernity. The streets are excellently paved, the inevitable plaza is well stocked and well kept, palms and sub-tropical flowers appearing in refreshing and pleasing contrast to the barrenness of the pampa that forms a background to the city, as viewed from the sea. There are delightful drives in the vicinity, a country club and several town clubs, and at least one hotel that offers comfort and cleanliness.

It is a day's journey from Antofagasta to Calama. The railroad was built by means of British capital, the shares being one of the most attractive and at the same time one of the most speculative investments on the London Stock Exchange. The original purpose of the road was to provide means for the transport of nitrate to the coast: in this connection its traffic figures are amazing. In spite of the fact that the gauge is only 30 inches, this railroad is supposed to hold the world's record for freight carried in proportion to its rolling-stock. However, a favorable factor is seen in the circumstance that there is an ample down-hill grade from the nitrate fields to the coast, so that most of the power is consumed in the haulage of empty flat cars and trucks from the port to

the pampa. In spite of the diminutive width of the road-bed, the Antofagasta & Bolivia railroad can boast of an excellent service of trains. The dining-cars are small but comfortable; and the meals served, considering the conditions, are good. Daily trains run between Antofagasta and La Paz, in Bolivia; and there are also two night trains every week. Comfortable sleeping accommodation is provided, but the booking of a *reservado* several days ahead is a wise precaution. The journey to Calama takes about 10 hours; the day train leaves Antofagasta at 8 o'clock every morning, arriving at Calama about 6 o'clock in the evening. The journey is entirely across the arid pampa of central Chile; the view from the open windows of the train is unrelieved by the sight of a single blade of grass or even an occasional tree; the country is bare of vegetation and devoid of water, for it seldom, or never, rains; and Darwin, observant naturalist though he was, could find nothing living except a small lichen that had grown on the bones of a dead mule! Nothing relieves the monotony except the sight of an occasional nitrate *oficina*, with its plant of crushers, boiling-vats, and *bateas*; or the sound of an explosion from a near-by *salitrera*, where the *caliche* is being mined and sorted, for transport to the loading station in carts, and from there to the *oficina* in the cars of a narrow-gauge railway. The last stage of the journey, between Calama and Chuquicamata, is made, through the courtesy of the Chile Exploration company, by automobile.

First impressions are often the most lasting, especially if pleasant. After a dusty and somewhat tiring train journey, the thoughts uppermost in one's mind are of home comforts; and these are precisely what the company has provided in the guest-house at the mine. Visitors are by no means uncommon. A number come from all parts of Chile to take advantage of the services and skill of a surgeon whose name is a household word in that part of South America, Dr. W. F. Shaw. Others travel there for business and professional reasons. Many make the journey for the purpose of viewing the greatest copper mine in the world, as I did. To one and all the guest-house at Chuqui, as the camp is called, is voted to be patterned along lines that many other mining concerns might well copy, for this sincere form of flattery is certainly deserved. The house itself is equipped according to American ideas of comfort and convenience; the cuisine equals that of the majority of first-class hotels; the guest is at his ease from the moment of arrival. One of the company officials lives in the house and acts as host, performing his duties with tact, and speaking Spanish or English according to the nationality of his guest. The sense of appreciation toward the company and its officials is brought down to a personal basis, for which visitors are glad to make due and fitting acknowledgment; a charge of 18 pesos per day relieves one, to some extent, from any uncomfortable feeling of pecuniary obligation toward the company. The entire arrangement ensures the comfort and pleasure of the guest, and might well be adopted by other industrial concerns operating under similar conditions.

The Chile Exploration Co. is essentially a Guggenheim enterprise, being controlled by the Chile Copper Co., which owns all the capital stock. The financial resources of the parent company are illustrated by the fact that it has a capital of \$135,000,000. The shares have a par value of \$25 each; 3,800,000 have been issued, and are listed on the New York and Boston stock exchanges; 600,000 are held for the conversion of 10- and 15-year gold bonds, aggregating \$50,000,000, which are due in 1923 and 1932, respectively. Extreme prices for the shares on the New York Stock Exchange during the past three years have been as follows:

	1920	1919	1918
High	214	192	24
Low	77	167	141

Extreme prices for the bonds during the past three years have been as follows:

	Bond	1920	1919	1918
High {	7%	1087	128	1184
	6%	864	95	894
	7%	874	1014	1024
Low {	7%	62	824	77
	6%			

It seems that Daniel Guggenheim, head of the firm of M. Guggenheim's Sons, first heard of the Chuquicamata mine in 1900. The firm turned the proposition down; but it must be understood that this step indicated no faulty judgment on their part; the only mines in which they were interested at that time were those containing ores that could be smelted, the leaching of low-grade material on a commercial scale being then unheard of. In 1911, correspondence took place between the Guggenheims and A. C. Burrage, of Boston; the property was shown to consist of a large number of claims that were owned by several syndicates and individuals, both Chilean and foreign. Between 1910 and 1911 a number of options were secured by Burrage; these were afterward taken over by the Guggenheims. A company was incorporated in New Jersey early in 1912, with a capital of \$1,000,000, in \$100 shares, the entire stock being held by the Chile Copper Co. The financial negotiations have not escaped litigation. In 1913, Louis Ross brought suit against Burrage in an endeavor to obtain 10% of the profit secured by the latter in the flotation of the company. Ross maintained that he was the original discoverer and that he had obtained the options for Burrage, working under a salary and a written agreement as regards commissions. After prolonged litigation, both suits were decided in favor of Burrage, the first by a decision of a lower court, from which Ross took no appeal, and the second by opinions of the Massachusetts Supreme Court in 1919 (233 Mass. 439, 124 N.E. 267) and on March 7, 1921 (130 N.E. 80). In 1916, the firm of M. Guggenheim's Sons was succeeded by Guggenheim Brothers. The change was one of the results of a suit that was brought by William Guggenheim against his brothers because of alleged unfairness in the division of profits arising out of the Chuquicamata flotation.

Chuquicamata marks the site of one of the ancient mines of the Indians, of which there are a vast number

in Chile. Old workings are numerous in the vicinity, and mummies are encountered from time to time as the work of stripping proceeds. The product from Chuquicamata, unlike that of the sister American enterprise (Cerro de Pasco) in Peru, was always copper, and was doubtless extracted by the natives for the making of ornaments. The mining area at present consists of 302 claims, and covers 2080 acres. Development work commenced in 1912, Pope Yeatman being consulting engineer. Sixty-three prospect holes were put down, totaling 44,185 ft. The average depth of the holes was 701.3 ft. The deposit was in this way determined to be composed of three classes of ore; the thickness of the ore was proved to be as follows: oxidized, 351 ft.; mixed, 228 ft.; and sulphide, 335 ft. The deepest hole disclosed ore of good grade at a depth of 1685 ft. Some trouble was experienced with acid water, but not on account of the action on the bits. The wire ropes used in connection with deep drilling were corroded, and delays resulted, but most of the drilling was done with manila rope. The depth to which the drilling was carried offers no evidence as to the depth of the deposit; many of the holes were in good ore when drilling was discontinued. It was noted, however, that the copper, in the sulphide zone, is occluded, and does not occur in the fissures and cracks; the treatment of this particular ore will, therefore, probably involve fine grinding; a concentrating, and not a leaching, process is certainly indicated.

The geology of the Chuquicamata deposit has been described at length by Waldemar Lindgren, Professor of Geology in the Massachusetts Institute of Technology; also by Fred Hellmann, Pope Yeatman, and others. The following notes, kindly supplied by the technical staff of the company, indicate the important features:

The country-rock in and about Chuquicamata is granite. It has sometimes been erroneously called granodiorite, but it consists essentially of feldspar, hornblende, and biotite, with sparse quartz inclusions. The orebody comprises a shear-zone within this granite area, which has been mineralized by solutions probably coming from great depth and connected with the basic intrusions that may be noted in the neighborhood. The mineralizing solutions have deposited the primary ore-minerals, enargite and cupriferous pyrite, in the fissures and on the joint-planes within the shear-zone. The deposited material did not impregnate the rock itself. This fact is of economic importance, because it enables the acid used in the lixiviation of the ore to reach the copper and to dissolve it with little difficulty, thus avoiding the necessity of fine grinding, as well as the added expense and the liberation of impurities contained within the country-rock. As it is, the ore is singularly free from impurities; the mineral occurs in such a way as to permit of the ready and rapid extraction of the copper.

Subsequently, erosion, oxidation, and metamorphism of this original orebody produced the rich area, consisting essentially of brochantite and chalcocite, out of the original ore-minerals, which were enargite and cupriferous

pyrite. It is believed that this oxidation occurred at a time when the rainfall was abundant, or, at all events, was much greater than it is at present, and when, as a result of this rainfall, there was much water in circulation on the surface of the ground and at moderate depth. The upper portion of the deposit was undoubtedly leached at that time; its copper contents were carried downward by the descending waters, and re-precipitated on the primary minerals below, thus forming a secondary enrichment composed of chalcocite. It is likely that this period of enrichment was followed by a considerable amount of erosion, for the upper cap was swept away and the enriched mineral was exposed. With decreasing rainfall and greatly diminishing circulation, the exposed chalcocite was gradually changed into brochantite, to a depth of about 350 feet.

It would appear that at a later period the orebody underwent a further alteration, due to the deposition on its surface of sulphates of lime and soda, and also of ordinary salt. These sulphates appear to have penetrated to a moderate depth and to have reacted in some measure on the existing minerals, turning the brochantite into ordinary bluestone of commerce (chalcantite) and combining as well to form a mineral known as kronkite, which is a mixture of sulphate of soda and sulphate of copper. These phenomena are mentioned in order to explain the many peculiarities of chemical composition and pseudomorphism that are in evidence, and that attract much attention; they are the result of the above-mentioned processes. The characteristics of the orebody today are, first, that in its upper levels it consists of a sub-sulphate of copper called brochantite, which is a mixture of the ordinary sulphate of copper with cuprous oxide. Then in the next zone, of a mixture of the oxidized ore and of the sulphide, chalcocite; then at a still lower horizon, of chalcocite alone; and lastly, of the original primary material, enargite and cupriferous pyrite.

The orebody as found today is an elongated mass, the direction of the long axis of which is approximately north and south. It is about 9000 ft. long, and has been proved for a maximum width of about 1300 ft. Its depth is as yet unknown, but the company's bore-holes show that it has a thickness of at least 914 ft. Assuming the depth attained and not going beyond it, and restricting the calculations to the area within the bore-holes themselves, the ore-reserves developed to date and in sight amount to 700,000,000 tons of an average content in copper of 2.12%.

By January 1913, 75,000,000 tons of ore, averaging 2.7% of copper, had been assured. By July 1913, the amount had been increased to 146,000,000 tons of 2.31% ore; and by January 1914 the reserves were estimated at over 200,000,000 tons, containing over 2% of copper. During 1914 an extra 100,000,000 tons was added to the reserves; and, during 1915 and 1916, 400,000,000 tons more. The graphic representation of drill-hole data was made by means of the pegboard method, which is de-

scribed by E. A. Cappelin Smith* as follows: A table was used to represent the datum plane, which would lie, in the case of the Chuquicamata deposit, about 1200 ft. below the surface of the earth. On the surface of the table a projection of the claim lines, as well as topographical features of importance, were laid out. The pegs used consisted of brass rods, cut so that their height represented the elevation of the surface at the various points; the tops of the rods, therefore, gave the surface contour of the deposit. Paper strips were graduated to represent intervals of 5 ft., with heavier divisions at intervals of 25 and 50 ft. These strips were wrapped around the brass rods, and glass tubes were slipped over them. Any legend on the paper remained clean; it was easily marked. The paper scales were painted in different colors at the various depths, to represent eap, brochantite, mixed brochantite and sulphide (one way if the former predominated, another way if the latter predominated), straight sulphide, and country-rock. The scales also bore little squares on which the copper assays at various depths were entered. Consequently, on looking across the pegs, a geological section of the deposit, in colors, could be seen, so far as drilling had determined it; and, by closer inspection, the depths and assays could be ascertained for any particular point. When further results on any drill-hole were received, the paper was taken off the peg, appropriately colored, marked to the new depth, and returned to its place.

Leaching tests were commenced in 1912 on a small scale. Composite and selected samples were taken from various sections of the deposits. The amounts experimented with were gradually increased from 100 kilogrammes to 2000 kg. and, lastly, to 14,000 kg. The success of subsequent operations was due largely to the completeness of the preliminary investigations, the final tests being made on a depth of ore equalling the height of the vat that was afterward used in practice. The solubility of the copper minerals was determined, and extensive experiments were made in an effort to anticipate the conditions that would be encountered in practice. An acid-proof material for lining the vats was developed and perfected, and much attention was paid to the question of the composition of a suitable alloy to be used for anode construction. The final decision was that a unit of 10,000 tons daily capacity should be erected, in which the ore would be crushed to about half an inch, and then leached with weak sulphuric acid; the solution would be dechloridized by treatment with metallic copper, and the copper would be recovered by electrolytic deposition.

Concurrently, the question of an adequate supply of power was receiving consideration. The company had obtained a concession for a water-power site from which it would be possible to obtain about 20,000 hp.; but, in order to economize time, labor, and first cost, and because this amount would be insufficient for the demands of even the first unit, it was decided to erect a steam-power plant at the coast, and to carry the power by overhead high-

tension lines to the mine. The available water-power will doubtless be utilized at a later date. The power-plant is situated at Tocopilla, a small seaport about 80 miles north of Antofagasta. Tocopilla was noted during the latter half of the 19th century as a copper centre of no small importance. Up to 1885, a number of large mines and smelters were in operation, all of them being under British control; the cessation of operations has been attributed to a combination of mismanagement and faulty technique. Today the town possesses one of the largest and most up-to-date steam-power electric plants in South America. The steam required for the original equipment was obtained from sixteen 2500-kw. Babcock & Wilcox tubular boilers. The fuel used is Californian oil, for which there is storage for 165,000 bbl.; economizers and steam-superheaters form a part of the equipment. The steam goes to four turbines of Swiss design constructed by the Escher-Wyss Co., of Zurich. The generators, of which there were also four, were made by the Siemens-Schuckertwerke, the current produced being of the three-phase 50-cycle alternating type at 5000 volts. The voltage is raised, in four Siemens-Schuckert 10,000-kva. transformers, and one 20,000-kva. General Electric transformer, to 110,000 volts. The overhead transmission line to the mine, 140 kilometres long, is carried on galvanized-steel towers, which are spaced according to the topography. The transmission consists of three 7-strand cables of 000 gauge (Browne & Sharpe) copper wire; ground wires are carried above the power cables. The insulators are of a tested capacity of 250,000 volts. At Chuquicamata the high-tension current goes to substation A, where four 10,000-kva. transformers and one 7500-kva. Westinghouse transformer reduce the pressure to 5000 volts. A portion passes to seven motor-generator sets and four rotary converters, a portion to substation B, where three 1000-kva. transformers reduce the current to 525 volts, at which pressure all the alternating-current motors on the property are operated. The current used for the electrolysis of the copper solution from the vats is of 250 volts.

Construction of the new plant began in January 1913. Orders for much of the electrical machinery had been placed in Germany; all went well until the outbreak of the War, when it was realized that a dozen or more English and German ships on the high seas were laden with equipment that was essential to the success of the Chuquicamata enterprise. An agreement was reached with the Allies; the machinery was transferred to neutral bottoms, and ultimately delivered at the mine. The Allies, in return, secured a quantity of copper when the plant was in operation. 'It's an ill wind that blows nobody any good'. The War helped the Chile Exploration Co. to a considerable extent. The nitrate fields had been producing at excess capacity to meet Germany's enormous pre-war demands for fertilizer. Then disorganization occurred. Ocean traffic was impeded, and Germany made an effort to keep a lane open between the Chilean pampa and the Fatherland; von Spee, the German admiral, terrorized the West Coast of South

*E. & M. J., May 16, 1914.

America; the nitrate industry was paralyzed. The complete destruction of Admiral Cradoek's squadron off the Chilean coast on November 1, 1914, was an example of superior strategy and superior armament; it marked the extinction of the sentiment, upheld by Cradoek, that boldness, morale, and valor, would decide the day. The Germans were flushed with victory; their fleet put into Valparaiso and, foolishly for them, took aboard a number of reservists. An Englishman put two and two together; he surmised that the fleet would double the Horn and make a dash for home. He cabled his views to London. The supposition seemed feasible. Fisher sent a squadron headed by the battle-cruisers 'Invincible' and 'Inflexible' under the command of Sturdee. The Germans were caught off the Falkland Islands on December 8 and were annihilated.

Owing to the restriction of output from the nitrate

man and other associates, the presentation was significant as recognizing the outstanding feature of really successful hydro-metallurgical work of recent date, namely, the enormous economic importance of gravity-leaching in the treatment of ores containing metals or salts in soluble form. The preliminary work, which was carried out to a large extent in the United States, anticipated to an unusual degree the results of operation on a large scale. A simple scheme of treatment was selected. The plan, as at first devised, was to crush in No. 10 gyratory crushers; but the opening was found to be too small; primary rock-breakers had to be installed later. Garfield rolls were chosen for final reduction to $\frac{1}{8}$ inch, but disc-crushers were found later to be preferable. The essential features of the disc-crusher cannot well be over-emphasized. The material is fed centrally between the discs, and is thrown by centrifugal force toward the periphery, where it is



THE POWER-PLANT AT TOCOPILLA

fields, the Chile Exploration company was able to engage labor on a large scale. Progress in the erection of the plant was rapid, the first unit being completed on May 15, 1915, little more than two years after the starting of the work. The high price of copper provided a big incentive for haste. It was estimated that copper could be produced for six cents per pound, delivered in the United States or in Europe. The mining and treatment cost per ton was anticipated to be \$2.106.

It speaks well for the technical organization of the enterprise that, comparatively speaking, so few alterations were made in the original design of the plant. The success of the metallurgical side of the operations is associated to a great extent with the name of E. A. Cappelín Smith, to whom the Mining and Metallurgical Society of America awarded its gold medal in 1920 for "distinguished service in the art of hydro-metallurgy". Although the honor was modestly disclaimed by the recipient, who emphasized the great services of Pope Yeat-

crushed; the discharge takes place in the same direction, and is aided by the centrifugal action; the ore travels in the direction of an increasing area of discharge, thus obviating the lowering of efficiency and minimizing the fine crushing of ore on ore that occurs in rolls. Leaching could also have been carried out on a deeper bed of material. The shoveling-slats in the leaching-vats were laid at right angles to the direction of operation of the grab-buckets, instead of in line with it. A 1000-ft. belt-conveyor was erected for the disposal of residue, to be superseded later by cars and locomotives. The copper solution before going to the electrolytic vats was de-chloridized by passage through tube-mills containing shot-copper, the idea being to settle, in Dorr thickeners, the cuprous chloride formed, and to filter the sludge, preparatory to smelting, in presses. The de-chloridizing process has been modified, as will be described later. The Dorr thickeners are now operated as gravity settlers and without the use of the customary mechanism; the tube-mills are filled

with scrap-iron instead of copper, and the necessity for the filter-presses no longer exists. The anodes in the electrolytic department were to be made from magnetite. These were purchased in Europe, but the War soon cut off the supply. Duriron, which had been tried as an anode material in the Perth Amboy tests, was substituted for magnetite, although a considerable increase (about 13%) in power consumption resulted. The anodes are now cast at the mine from ferro-silicon that is made in an electric furnace. The acid-plant is in excess of present requirements, although it will probably be an asset when extensions of plant are made. The ore was found to contain a large proportion of the acid required for dissolving purposes.

Errors of judgment in the preliminary planning of so vast an undertaking have been few and far between. It is refreshing to leave the piles of scrapped 'up-to-date' machinery at the more 'progressive' nitrate *oficinas* and to reach Chuquibambata, where practice has been based on sound fundamental principles of metallurgy and economics, rather than on the dictation of reformers who are, too often, interested in the application of the machinery, the use of which they advocate.

(To be Continued)

Aluminum

*Aluminum is the lightest of the common metals, and has a specific gravity 2.58 in the pure cast condition. The metal is malleable between 100° and 150°C. It can be forged and rolled, drawn into tubes and fine wire, stamped, pressed, and beaten into thin leaves. Assuming an electrical conductivity of 100 for pure copper, aluminum has a conductivity of about 60. Commercial aluminum usually contains from 98 to 99% of the metal, but ingots can be obtained containing only 0.3 to 0.5% of impurities. The most objectionable impurity is sodium, of which not more than traces should be present. Other impurities include silicon, which should not exceed 0.5%, and iron, which should not exceed 0.3% in high-grade aluminum.

The chief aluminum minerals are corundum (alumina), bauxite, hydrargillite and diaspore (hydrated oxides), cryolite (a fluoride of aluminum and sodium), alum, alunogen, and alunite (sulphates) and numerous silicates, including the feldspars and clays. Cryolite is found in commercial quantities only in southern Greenland, where it is mined at Ivigtut, on the Arauktjord. This mineral was formerly the only ore of aluminum and it is still used as a flux in the extraction of the metal. It is also used in enameling iron-ware and in the manufacture of portland cement.

The Ivigtut deposits are owned by Kryolith Mine and Handelsselskabet, A/S, Copenhagen, Denmark, which holds a State concession for mining. The product is sold to the Pennsylvania Salt Manufacturing Co. of

Philadelphia, and to Oresunds Chemiske Fabriker, Kommanditselskab ved C. F. Jarl, Copenhagen. Canada obtains its supplies through the American agents.

Bauxite is the most important source of aluminum and its salts. It is a mixture of the hydrates of aluminum and iron, with a certain amount of silica, silicates, and titanium oxide. Its color varies from gray to red, according to the percentage of iron. Its composition ranges generally between the following limits:

Alumina	30	to 60 %
Ferric oxide	3	" 25 "
Silica	0.5	" 20 "
Titanium di-oxide	0	" 10 "

Bauxite is employed (1) as raw material in the production of metallic aluminum, (2) in the manufacture of aluminum salts, (3) in the manufacture of refractory bricks, (4) in the manufacture of alundum (fused alumina) for use as an abrasive, and (5) in the refining of oil, a use of growing importance.

The greater part of the world's output is employed in the production of metallic aluminum. For this purpose the percentage of silica and titanium oxide should be as low as possible, but a certain amount of iron-oxide is not injurious except so far as its presence means a decrease in the alumina content. In the manufacture of chemicals such as alum, aluminum sulphate, and other salts, comparatively pure bauxite is used, and it is desirable that the material should be as free as possible from oxide of iron. For some purposes, practically pure hydrated alumina must first be obtained.

Large quantities of light alloys of aluminum, with copper alone, or with that and other metals, such as magnesium, have been used for war purposes, chiefly in the manufacture of aeroplanes and airships, but also in machine-guns of the air-cooled type, in the manufacture of ammonal and other explosives, in soldiers' helmets, and other parts of their equipment. Other uses include wireless telegraph and telephone apparatus, barometer cases, and camera parts. The use of aluminum dust in place of zinc-dust for precipitating precious metal from cyanide solutions is increasing. Aluminum is also largely used in the Thermit process of welding and casting, aluminum in fine grains or filings being mixed with the oxide to be reduced. On being heated by a priming, such as magnesium powder, the aluminum combines violently with the oxygen, generating great heat, producing a fluid slag, and setting free the metal, thus proving useful in the welding of steel rails.

The Central Powers were seriously short of supplies of bauxite during the War, and the urgency of their need led to attempts to extract the metal from clays. In Norway it has been proposed to extract aluminum from the feldspar labradorite.

All the bauxite produced in the United Kingdom comes from Ireland. It occurs associated with the pisolitic iron ores and laterites of Antrim, in the area lying north and north-east of Lough Neagh, between Belfast Lough and the north coast of the county.

*Abstracted from a pamphlet issued by the Imperial Resources Bureau, London.

Underground Haulage for Mines of Moderate Size

By Girard B. Rosenblatt

*The selection of the most suitable system of haulage for the metal mine of moderate output—say 500 to 2000 tons of ore per 24 hours—deserves more careful consideration than is generally accorded to it. The advantages of mechanical haulage are generally recognized, but a cost analysis of the various systems available is not generally made before deciding upon the type that will be installed. First cost is frequently given more or less careful consideration, but factors affecting the cost of operation are often overlooked. It is the purpose of this paper to discuss some aspects of the problem that should be considered in determining what system can be installed most advantageously.

This is not a brief for electric haulage, but I believe it will be admitted that on account of the flexibility, reliability, and comparative simplicity of electric locomotives, this form of mechanical haulage will prove most applicable in the majority of mines. Gasoline locomotives and compressed-air locomotives have their particular fields of application, but these fields are limited. The proper field of the gasoline locomotive is to haul small tonnages over comparatively long distances on temporary work under conditions where it is more important to keep low the total initial investment than to secure continuity of service or economy of operation and maintenance. The particular field of the compressed-air locomotive is to transport large tonnages over long hauls where conditions necessitate heavy trains, but where the physical surroundings prohibit the installation of a trolley or third rail. For all other conditions electric haulage can be proved to be superior.

When we come to a consideration of electric haulage we are immediately confronted with the necessity of choosing between two distinct systems of power-supply, namely, trolley or storage-battery. A decision having been made on that point, it next becomes necessary to select the unit of proper size. And that point being settled, there finally comes the selection of the desired equipment from among the products of the different manufacturers. This paper will not treat of the advantages and failings of equipment made by different manufacturers, nor will it cover the method of calculating the proper size of haulage-units to be used. But it will endeavor to point out the advantages and limitations of the systems that can be selected and certain considerations that should be borne in mind in arriving at the most desirable type and size of equipment.

In selecting haulage equipment, the primary thought to bear in mind is that mechanical haulage is to be installed in order to help the mine make money. It makes

money by saving expense. The type, size, and make of equipment that will handle a given output with the least expense is the logical type to install. Do not select your haulage system on the basis of lowest first cost alone; nor on the basis of some individual's preference. First cost and personal preference are factors entering into the problem, but they are not the only, nor even the predominating, factors to be considered. Select your haulage as engineers should; that is, on the basis of a complete logical analysis. And the foundation of such analysis should be *cost per ton of ore hauled*.

The principal factors that enter into the cost per ton of ore hauled are:

- Reliability.
- Operating labor expense.
- Maintenance expense.
- First cost of the complete installation.
- Safety.
- Flexibility.
- Personal preferences.
- Power consumption.

Upon the reliability of its component parts depends the continuity of service that the haulage system will render. Interruptions mean money lost. Delays in continuous service are expensive. A locomotive out of service for repairs, a train held up on account of a trolley-wire down, mean money going out and none coming in. Not only is there involved the expense of putting the locomotive back in service or of stringing up new wire; in addition interest charges are going on: ore is piling up in the chutes; perhaps even the output of the mill is being reduced. Select your haulage equipment so that, for your particular conditions, time-out-of-service will be a minimum. To do so will reduce your costs per ton hauled by keeping up the tonnage for a given investment.

Upon the selection of the proper size of locomotives will depend largely the operating labor expense. Every locomotive must have a motorman. In many States every train must have a trip-rider as well. Locomotives smaller than necessary mean more trains for a given output and consequently more wages per ton hauled. Make your trains long enough to keep the number of locomotives required down to a minimum, but of such size as to keep those locomotives busy. Locomotives standing idle and motormen loafing, run up the cost per ton of ore. Train-length up to a certain limit spells economy, but above that limit, too long a train means unnecessary expense, for very long trains are more subject to derailment than short ones; they cause confusion at stations; and offer some difficulties when loading from chutes. Wider gauges and heavier rails permit longer trains. There is an economical length, depending largely on the design

*A paper presented before the San Francisco Section of the A. I. M. & M. E., on April 22, 1921.

of car and the tonnage to be hauled. For the average small mine it is usually somewhere between 12 and 20 cars. The maximum weight of locomotive that can be used depends upon the gauge and weight of rail used. Often it will pay to use a wider gauge or a heavier rail than at first contemplated, in order to use heavier locomotives so as to haul longer trains and reduce the number of locomotives required for a given rate of output.

The accompanying table shows the allowable limits of the weight of locomotives to be used on rails of various weights and tracks of different gauge:

Weight of rail, lb.	Gauge of track, in.	Weight of locomotive, tons
12	18	4
16 .....	.....	6
20	24	8
25 .....	.....	10
40 .....	.....	15
..	36	20

Under 'maintenance expense' the upkeep of the haulage system as a whole should be considered. The upkeep of the overhead trolley-wire on a trolley-operated system should be included in considering the maintenance of a trolley-locomotive just as upkeep of the storage-battery is almost invariably included in figuring the maintenance of a battery-locomotive. In fact, for a fair comparison of real costs on a ton-mile basis there should be included:

Locomotive maintenance.

Car maintenance.

Track maintenance.

Battery maintenance, if any.

Trolley maintenance, if any.

Motor-generator maintenance.

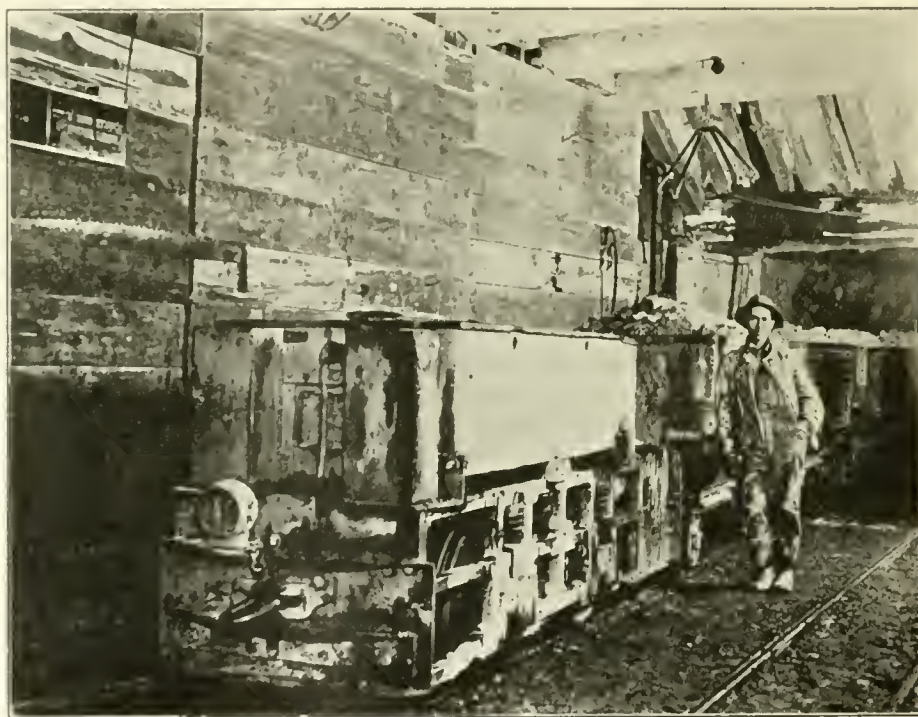
First cost should include consideration not only of the cost of locomotives and cars, but also of such factors as the cost of motor-generator or charging-stations, the stringing of trolley-wires, and the bonding of rails. The manner in which first cost enters into total operating cost is simply a matter of bookkeeping and will not be discussed here.

As to safety, all systems of haulage involve a certain accident hazard. The reduction of this hazard should receive major consideration. Apart from the humanitarian side of the problem, accidents are bad business. They are costly and they tend to reduce operating morale. A safe system goes far toward reducing the cost of haulage. The possibility of danger from electric shock is usually the feature particularly in mind in considering the accident hazard of electric-haulage systems. But there are others that should not be overlooked. They involve control and braking of the train, and protection

for the motorman in case of collision. I believe that fully as many train-operators are hurt in mining service by runaways and collisions as are injured by electric shock.

The value of flexibility in a haulage system is difficult to estimate. Yet it is quite real. Haulage systems can readily have a life of ten years or more. Few mines, especially lode mines, are operated on the same basis of development over ten-year periods. Physical conditions change, managements change, engineering ideas change, and metallurgical processes advance. A haulage system that may be ideal for present conditions may be a handicap ten years, or even two years hence, unless that system has a certain flexibility which will permit it being adapted to probable changed conditions. This aspect is worth thinking about.

Personal preferences enter into the problem of selecting haulage equipment on account of the personal element. Haulage equipment cannot be made strictly 'Tool-



4½-TON STORAGE-BATTERY LOCOMOTIVE IN THE HECLA MINE AT BURKE, IDAHO

proof' and operators usually get better results with equipment they like than with that they do not like. Features that render inspection easy, and that facilitate adjustments and lubrication, tend to lessen maintenance expense. A machine that is easy to oil is almost sure to get more frequent and more adequate oiling than one which is so constructed that periodic oiling becomes disagreeable and troublesome. Men will keep an easily adjustable machine in good adjustment, and will not so readily allow it to get in such bad adjustment that it must be withdrawn from service for repair in the shop.

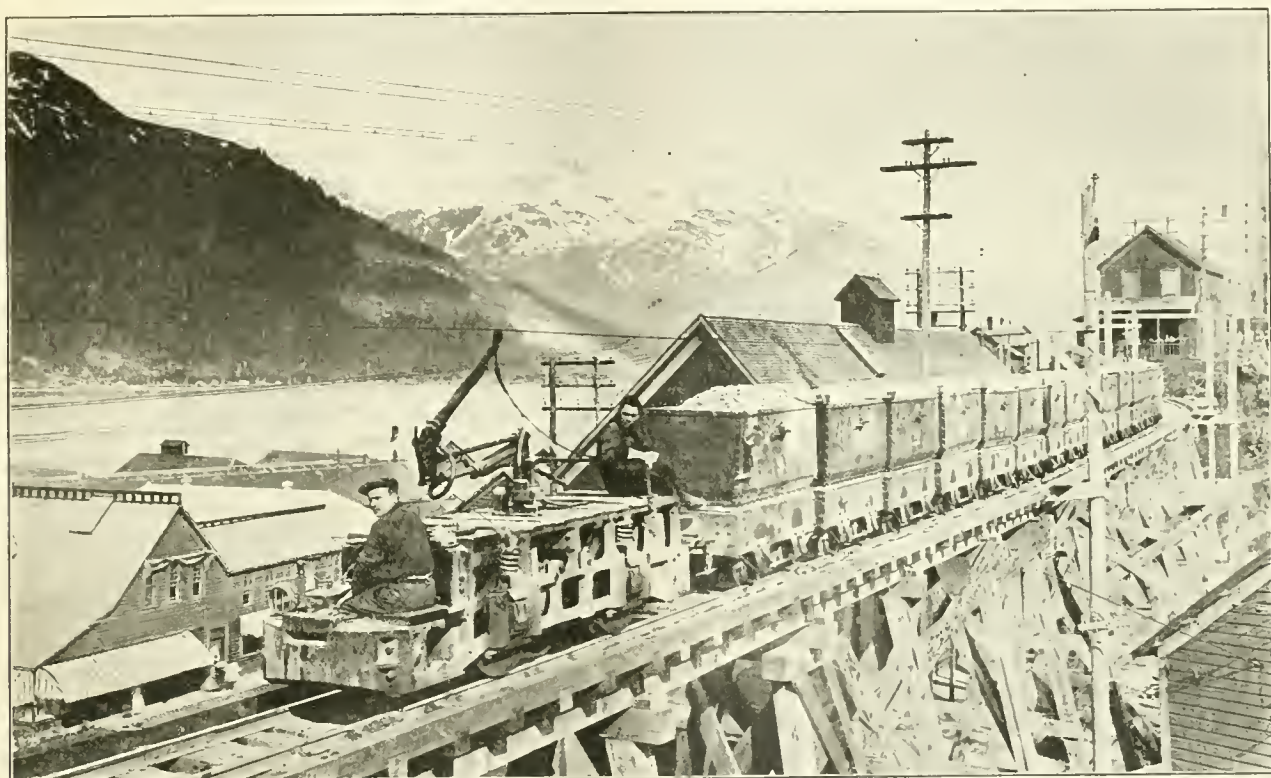
Power consumption enters into the cost of mine-haulage to a less extent than is usually realized. It is seldom of sufficient importance to govern the selection of the

particular system of haulage. In half a dozen mines regarding which I have reasonably accurate haulage-cost data, power constitutes only about 5 to 6% of the total haulage-operating cost. Ordinarily 10 kw-hr. will haul approximately 75 tons of ore per mile on level track under average mine conditions. At the usual figure at which a mine buys power, it can readily be seen that a variation of 10% in power consumption will not make a very great difference in the total cost per ton of ore hauled. Efficiency of the electrical equipment on the other hand is a matter of considerable importance, but not so much because of power consumption as because of the effect of efficiencies on securing a well proportioned haulage system. To explain: Suppose as a hypothetical case we have a small system operated by a

tery during a busy shift, or that an extra trip on overtime was necessitated in order to get out the requisite tonnage of ore, would increase haulage costs appreciably.

As a matter of fact, for average mining conditions the two systems—trolley and storage-battery—usually will not show a great difference in over-all power consumption. I know this is contrary to general impressions, but I have found it to be the fact in scores of instances that I have analyzed.

A consideration of the foregoing factors will aid in the selection of the most economical haulage system for any specific condition. No general rule can be laid down as to when trolley haulage or when storage-battery haulage can be installed to best advantage. Each problem must be investigated separately. However, a few



8-TON TROLLEY-LOCOMOTIVE AT THE ALASKA TREADWELL MINE

single storage-battery locomotive. A storage-battery locomotive carries its own power supply with it—on its back. Suppose the capacity of the battery is such that, with equipment having an efficiency of 70%, it is capable of hauling 100 tons of ore 10,000 ft. in five trips of 20 tons per train. If the electrical equipment had an efficiency of, say, 60 instead of 70%, this same battery capacity could make only $6/7$ the number of trips, or $4\frac{1}{2}$ trips. As fractional trips are impracticable, this reduction of 10% in the efficiency of the electrical equipment entails the necessity of re-charging the battery at the end of four trips, or of shortening the train hauled so that only 17 instead of 20 tons would be hauled each trip, giving an output of 85 instead of 100 tons in five trips. The fact that the inefficient equipment took 10% more power would not increase mining costs materially; but the fact that time was required to re-charge the bat-

generally applicable remarks indicating the trend of recent engineering experience may be of value.

As a simple, rugged, reliable piece of haulage equipment, the trolley-locomotive surpasses any other form of haulage motive power. As a means of moving trains quickly, irrespective of tonnage or distance, its superiority is unquestioned. The trolley-locomotive can be built for any speed that a mine track will stand. It can be subjected to almost unbelievable abuse, both mechanically and electrically; it can be plugged, derailed, 'slam-banged' into trains of cars, and yet stand up to the service with minimum deterioration. It is handicapped by just one feature, and that is that it requires a trolley-wire in order to be able to move about. Trolley-wires may be a menace to safety and interfere with flexibility. In heavy or moving ground and about loading-chutes it may be a decided nuisance and require con-

stant attention. Also, trolley wire and rail-bonds cost money to install and money to keep in condition.

The modern storage-battery mine-locomotive is not the delicate piece of apparatus its detractors claim it to be; in fact it is a mighty good mining machine, but it will not stand the abuse that a trolley-locomotive can withstand. Operated with reasonable intelligence and given decent maintenance it will perform most satisfactorily in mine service. But it does require in certain particulars, greater intelligence in its operation and greater care than does a trolley-locomotive.

The actual mining conditions usually decide whether trolley or storage-battery haulage is the better to install. For large tonnages over long hauls, the trolley system will almost universally prove most advantageous. For many frequent and diversified short hauls with moderate or small tonnages—gathering service as it is termed—storage-battery haulage will probably prove more suitable. For small tonnages over moderately long hauls, storage-battery haulage will generally prove more economical, particularly since the investment and maintenance charge of the trolley-wire and rail-bonding for a trolley system would necessarily be divided among a comparatively few tons of ore hauled.

Long straight adits in which high haulage-speed is permissible and desirable will always favor trolley-haulage. Poor roof conditions, on the other hand, cause storage-battery locomotives to appear most favorable, because a bad roof means trouble in keeping up the trolley-wire; and a trolley-wire down is not only a nuisance and expense, but it means a haulage system tied up until the electricians are sent for and arrive on the scene to clear up the trouble.

A mining system that involves constant advance of haulage-drifts favors storage-battery haulage, because the storage-battery locomotive can follow development as soon as rails are laid, whereas the trolley-locomotive has to wait for the stringing of trolley-wire with the attendant barring-down of the roof and re-alignment of the timbering.

Low roofs favor storage-battery locomotives as a matter of safety. Certain methods of stoping also are favorable to storage-battery locomotives in haulage-drifts because many forms of chutes prohibit a trolley-wire strung over the centre of the track, and such chutes, unless all are situated on the same side of the track, make trolley operation difficult.

Altogether trolley-haulage makes for speed and big output. Storage-battery haulage makes for convenience and flexibility. The variety in types of storage-battery locomotives that comparatively recently have been placed on the market emphasizes the flexibility that can be attained with this form of haulage. Two or three manufacturers now sell a small narrow-gauge single-motor storage-battery locomotive that is particularly suitable for development work. This is a small light machine weighing about $2\frac{1}{2}$ tons and available for gauges down to 18 in. It has limited pulling-power and a limited range of travel, but it will go almost anywhere and can displace three or four mules at a decided saving in cost of operation. At least two manufacturers now make a 'midget' locomotive—a small tandem affair built in two halves; the leading half carries the motor and the motor-man, while the trailing half carries the battery. Each half is of such dimensions that it can be run onto the ordinary mine-cage just like a mine-car. It can thus be shifted from level to level with the greatest convenience. Coupled together the two halves constitute a decidedly respectable haulage-unit that will develop about 400 lb. drawbar pull at approximately $3\frac{1}{2}$ miles per hour. The unit has short wheel-base so that it can take any reasonable curve. It is less than four feet high, so that it can go into low drifts and snake cars from any place where rails are laid. To date it marks the ultimate in all-round flexibility.

The figures in the accompanying table analyze the cost of transportation at various mines in the United States and Canada during the years 1916, 1917, and 1918. These data show how the various factors enter into the total cost of moving ore. They have been obtained by carefully calculating to a ton-mile basis the costs as prepared by the mining companies themselves. The comparatively small importance of the item of power is notable in contrast to the large cost for operating labor and maintenance.

Zinc forms the base, according to a U. S. Geological Survey bulletin, of four white pigments: zinc oxide, leaded zinc oxide, zinc-lead oxide, and lithopone. All these may be, and in the United States the first three usually have been, made directly from zinc ore. No zinc-lead oxide has been made since 1909, when the plant at Cañon City, Colorado, was closed. The output of zinc oxide and leaded-zinc oxide has not been disclosed.

Table Showing Costs of Haulage in Cents per Ton-Mile of Ore Hauled

	Storage-battery	Storage-battery	Storage-battery	Trolley	Storage-battery	Storage-battery	Trolley
	3-ton	4-ton	3-ton	3-ton	$3\frac{1}{2}$ -ton	$6\frac{1}{2}$ -ton	$3\frac{1}{2}$ -ton
Weight of locomotive.....	3-ton	4-ton	3-ton	3-ton	$3\frac{1}{2}$ -ton	$6\frac{1}{2}$ -ton	$3\frac{1}{2}$ -ton
Capacity of car, pounds.....	2000	2000	1500	1800	4000	6000	1800*
Power	1.58	1.58	3.33	2.32	3.7	1.5	2.2
Operating labor and material.....	35.8	29.5	60.0	19.8	36.8	34.0	35.0
Total operating cost.....	37.4	31.1	63.33	22.1	40.5	35.5	37.2
Locomotive maintenance	3.69	0.44	....	....	....	3.15	1.8
Car maintenance	11.1	6.07	....	....	....	6.45	7.5
Track, trolley, and station maintenance	23.2	5.8	....	....	....	0.35	11.0
Total maintenance cost	38.0	12.3	10.7	13.3	5.3	9.95	19.3
Total cost	75.4	43.4	74.0	35.4	45.3	45.45	56.5

*Figures only approximate.

REVIEW OF MINING

COPPER PRODUCTION DURING APRIL

The closing down of most of the large copper mines has resulted in a comparatively small number of companies reporting production results for April. To date but eleven copper companies have made known their April production; of these 50% are now closed down so far as production is concerned. May, therefore, will be an extremely lean month. The eleven companies that have announced their April production figures show a combined production of 127,578,355 lb. for the first four months of this year, a drop of 31,711,930 lb., as compared with the corresponding period of 1920, and a decrease of 21,278,354 lb. from the first four months of 1919. The following compares the refined copper production by the eleven companies that have reported for the first four months of the last three years, the figures being in pounds:

	1921	1920	1919
Arizona	8,300,000	12,000,000	11,800,000
Calumet & Arizona.....	11,427,672	13,978,000	12,042,000
Cerro de Pasco.....	17,804,000	18,954,000	20,040,000
East Butte	5,164,580	6,400,760	5,973,320
Kennecott	25,138,500	34,322,660	24,712,000
Mohawk	4,228,268	4,190,203	4,736,823
New Cornelia	8,230,870	13,948,000	14,654,000
Old Dominion	7,887,000	9,146,300	10,135,000
Phelps Dodge	27,395,000	31,316,000	37,659,909
United Verde Extension...	12,613,990	13,902,600	5,284,508
Wolverine	1,388,409	1,131,762	1,819,149
Total	127,578,355	159,290,285	148,856,709

P. G. BECKETT, GENERAL MANAGER FOR THE PHELPS DODGE CORPORATION, IS OPTIMISTIC

That the crisis in the copper situation has passed and that the question now confronting the mining companies is the rapidity with which economic conditions in the country will return to normal, was the statement made by P. G. Beckett, general manager for the Phelps Dodge Corporation, at Tucson recently.

He is quoted as saying: "Conditions are naturally quiet now at many of the mining camps. Our branches at Tyrone, New Mexico, and at Morenci, are completely shut-down, and at Bisbee, the Copper Queen branch, we are doing considerable development work in the mines. We are also doing stripping work on Sacramento Hill and are completing construction of a 4000-ton concentration plant, which should be finished by fall, at the property of the Moctezuma Copper Co. at Nacozari, Mexico.

"We are also completing construction on a new concentrator and giving employment to several hundred men at the mines by doing certain development work. While it is difficult to appear in the role of a prophet at this time, I believe it safe to say that as conditions in this country and in Europe become better readjusted a gradual improvement will develop in the copper industry in this country. And while it is impossible to say just how long a time will elapse before the Phelps Dodge properties are justified in resuming production, the fact that practically all large copper producers of this country have completely suspended copper production will hasten the time.

"It is now generally recognized that with the overwhelming surplus of copper there was on hand in the spring of this year, the quickest way to a resumption of healthy conditions

in the mining industry in Arizona was a complete stoppage of copper production until a great part of the surplus could be absorbed. It may be said that the worst is over, and it is now a question of how quickly economic conditions here and abroad return to normal."

I. W. W. ORGANIZER IS SENT TO PRISON

A. S. Embree, one of the leaders of the I. W. W., who has been actively connected with strikes in various Western mining districts, has been convicted in the Superior Court at Wallace, Idaho, of criminal syndicalism, and sentenced to serve a term of from one to ten years. Embree admitted on the stand that he was a member of the I. W. W. and that for two months in 1918 he acted as supreme officer in Chicago during the absence of William D. Haywood.

Embree was active in the strike in the Warren district in Arizona in 1917, and was one of the executive committee that signed the I. W. W. demands. He was deported on July 12, 1917. He later returned and was arrested on a charge of inciting a riot, and was tried at Tucson, a change of venue having been taken, and was acquitted. He went to Phoenix, where he had charge of the I. W. W. headquarters, and later went to Butte, where he was active in the work of the organization there. Embree then went to Idaho and was arrested while circulating literature of the organization and making speeches in its behalf. His arrest occurred about six months ago. Embree was to have been tried last August but his case was postponed until the present term of court.

ARIZONA

Ajo.—Mining operations of the New Cornelia Copper Co. have been reduced to the minimum. The company could not shut-down entirely because of the damage to its plant and equipment. It has thousands of gallons of sulphuric acid and other leaching solutions in tanks at its reduction works which cannot well be disposed of and if allowed to lie idle would quickly deteriorate. The company will continue to run one steam-shovel on an eight-hour shift at its mine. This will entail the employment of approximately 300 men. The town of Ajo is completely dependent upon the operation of the mine, as is also the railroad connecting Ajo with Gila on the Southern Pacific line. Net working capital today is approximately the same as at the close of last year, namely, about \$4,750,000.

Bisbee.—No further reductions in wages in the district are contemplated, according to G. H. Dowell, general manager of the Copper Queen branch of the Phelps Dodge Corporation, who spoke before a meeting of business men of the district. Dowell spoke to put at rest rumors to the effect that there would be further cuts in the near future. The speaker said that the Copper Queen is now employing about 1300 men in the district, with a monthly payroll of \$180,000. The Calumet & Arizona, the second largest producer in the district, is employing about 600 men. Both companies are carrying on extensive development work during the period of the suspension of production.

Clifton.—Recent developments in the Volcano mine, situated seven miles from Steins, New Mexico, indicate that this

silver producer of 20 years ago may become important. C. W. Mitchell, mining engineer of Silver City, has recently found a rich vein, 12 ft. wide, on the 100-ft. level. Further development work is now being done.

Tombstone.—The mill of the Tombstone Co-operative Mining Co. is in regular operation on 7-oz. silver ore from Springer & Hilton lease. Assays of the concentrate, which represent from 75 to 80% recovery, average 373 oz., according to V. C. Mellgren, manager of the mill. The cyaniding equipment is being installed and all 'muddings' will be cyanided. There are eight independent lessees interested in the project and each lessee furnishes the labor required to put through his ore, which cuts the expenses to a minimum. Power is supplied by a gasoline engine. Once dumped into the bin all ore is automatically handled through the rolls into the feed-boxes and onto the tables, the flow being by gravity.

CALIFORNIA

Bodie.—Gold ore from the Miller, Gray, and Granger-Miller leases is being crushed. This is the first time the stamps have dropped for many years.

Grass Valley.—H. M. Black and associates, who are engaged in unwatering and repairing the shaft of the Iron-clad mine in the Rough and Ready district, have worked down a distance of 50 ft. The shaft is the deepest in the Rough and Ready district, being sunk to a depth of 400 ft. The old records show that excellent assays were secured at the point where work was suspended.

A meeting of mining men from various districts of upper California was held here last week. Among those attending were Bulkeley Wells of Denver, head of the Idaho-Maryland development, W. J. Loring of San Francisco, B. I. Hoxsie of Amador City, O. McCraney of Shawmut, F. O. Lincoln of Reno, and Alfred Hunt of Angels Camp. George W. Starr, J. A. Fulton, A. D. Foote, and Arthur B. Foote were among those who met the visitors and took them on tours of the different mines.

Nevada City.—The Quaker Hill Mines Co.'s property, 12 miles east of here, are to be sold at Commissioner's sale to satisfy a mortgage of \$150,000. This is according to a decision of Judge George L. Jones in the Superior Court. Judgment in the suit for foreclosure was given in favor of the plaintiff after the testimony had been heard. The plaintiffs, Harold Nathan et al. of San Francisco, were trustees under the mortgage of \$150,000, which was given as security on \$200,000 of the Quaker Hill company's 6% bonds. Unpaid interest on the mortgage amounted to over \$10,000. The mines are in active operation.

Portola.—Development work being done on the main-tunnel level of the Walker mine has established the fact that the gold and silver content of the ore is materially greater than in the upper levels. The ore is being stored on the dump; 10,000 tons of concentrate is awaiting shipment. Fifty men are employed. Improvements to the mill, consisting of the installation of a large crusher and the erection of larger ore-bins are under way.

Redding.—Twenty-four placer-mining claims totaling 3840 acres, have been located by interests connected with the Weed Lumber Co., of which J. M. White is manager. The claims are valuable for rich deposits of diatomaceous earth, which are said to be unusually free from iron.

COLORADO

Cripple Creek.—Recent shipments from the new discovery in the Lily vein at the 2000-ft. level of the Vindicator Consolidated company's No. 1 or main shaft, have brought settlement at from 10 to 12 oz. gold per ton. The shoot is reported opened for 350 ft. in length with a width of from four to five feet; 90% of the vein-matter is shipping-grade ore.

Some \$25,000 worth of ore has been shipped from the Hardwood claim of the United Gold Mines Co., on Ironclad hill, by T. R. Countryman and associates in the past seven weeks. The ore shipped ranges from 3 to 8 oz. gold per ton. Good ore is reported from the Huena Vista vein of the Isabella Mines Co. at a depth of 1200 ft. The vein is about 3 ft. wide and the ore has been opened to date for about 75 ft.—High-grade ore has been opened by lessees on the fourth level of the Golden Cycle shaft of the Vindicator company.

De Beque.—The Monarch Shale Oil Co. has had its retort-plant in successful operation for three weeks. The company has contracts for supplying oil to be used in the flotation process. The Ginet furnace is used.

Durango.—The Mayday mines in the LaPlata district has been transferred to the Cumberland Mines Co., a Denver controlled corporation. The consideration is said to be \$100,000. The Mayday group of 14 patented claims has produced to date in excess of one million dollars. The controlling interest was held by the A. E. Reynolds estate. The property is fully equipped.—Cumberland Mines Co., organized in 1917, owns a group of claims eight miles from the Mayday group. A modern mill is now being built by the company, with a flotation unit, to handle milling ore developed on the Cumberland group.—Operations have been resumed on the Southern Boy, owned by Ralph Hutchinson, G. Stroebel, and G. Sheek. A rich strike was recently made on this property by lessees.—Lessees on the Idaho are mining and shipping smelting-grade ore to the Durango smelter.—The Clark group, situated near the Cumberland Mines property, is also active under lease.

Georgetown.—The Roosevelt Mining Co. has completed its new tram at Alice and is again operating both mine and mill. An orebody 75 ft. long has been opened on the Buster tunnel-level at a depth of 600 ft. from the surface and stoping has started.—The Rolland, on Brown mountain, has been leased for a two-year term. This claim was located in 1875.—The Silver Plume Consolidated Mining Co. is moving ore over the Snowdrift tramway to the company's mill.

Lake City.—The lessees on the Hidden Treasure mine, in the Galena district of Hinsdale county, are mining high-grade ore showing native silver, pronounced the richest ever mined on the property. The discovery was made in virgin ground with several hundred feet of ground above undeveloped. The Hidden Treasure lies north-east of the Ute & Ulay mine, that has produced in excess of \$11,000,000 and was operated several hundred feet below the deepest level of the Hidden Treasure. The lessees, McPolin and Halpin, should take out a fortune if the shoot holds as it is reported.

Telluride.—The Liberty Bell mine and milling plant were closed down last week and men laid-off. Mine equipment is being moved to the mill building for storage. The company's power contract having expired, the final mill clean-up will await thawing out of the Deer Trail water pipe-line when water-power will be substituted for electricity. The mine has produced steadily for 20 years.

Tiger.—The Tiger company is proceeding with the erection of a 300-ton mill and is sinking the I. X. L. shaft on its property 150 ft. farther to reach the 1000-ft. level. Other development is under way. Frank R. Wicks is general superintendent.

IDAHO

Coeur d'Alene.—M. J. Murphy, one of the owners of the Calumet mine $4\frac{1}{2}$ miles east of Burke, announces that work will be resumed as soon as supplies can be taken to the property.—It is reported that the cross-cut in the North Bunker Hill property, near Kellogg, is in 135 ft. from the bottom of the 500-ft. inclined shaft. In the last 10 days the

flow of water from the face has increased and it is believed the vein will be reached within 50 feet.

The Federal Mining & Smelting Co. has declared its second quarterly dividend this year. It amounts to 1½%, making a disbursement of \$210,000. The first quarter this year the company paid only 1%.—A raise will be run from the lower tunnel in the Silver Cable mine where good galena-zinc ore was found.—Improvement is reported in the orebody opened up in the West Sunset property. According to reports there is now five feet of high-grade silver-lead ore in the face of the drift that is being extended into the West Sunset mine. The ore was first entered in Sunset ground and was followed for more than 200 ft. before the drift entered the West Sunset holdings. The West Sunset group adjoins the Tamarack & Custer property.

Improvements are under way at the Jim Blaine property on Pine creek to cost \$2000. The group comprises 27 claims on Pine creek opposite the Nabob and is one of the oldest properties in the district. A tunnel, 600 ft. long, was driven in the upper workings where indications of lead-silver ore were found.

The mining interests in Idaho are demanding a tariff on all copper matte containing more than 7% lead imported to this country. The American Smelting & Refining Co. is seeking to have all copper matte containing up to 25% lead admitted free of duty. Representatives of Idaho's mines say that such competition would be injurious to the industry throughout the West.

MICHIGAN

Houghton.—With the shipment of 200,000 lb. of copper to Detroit last week, all metal orders on Calumet & Hecla's books, with exception of 200,000 lb. of wire bars, will have been filled. The C. & H. smelter is still operating though at less than half capacity. It has been working chiefly on special orders and if new sales are not soon made the plant will be shut-down entirely. A shipment of 1,200,000 lb. of copper was taken out this week by boat. This is a small consignment compared with usual cargoes. Of the amount 100 tons was Calumet & Hecla metal and the remaining 500 Copper Range and Quincy copper.

Seneca's developments on the 6th level, where the shaft is bottomed, continue to be encouraging. Both the north and south drifts opened 'rock' that compares favorably with the openings on the upper levels. The 3rd level drift, north, is proceeding in the direction of Gratiot with which it ultimately will connect. Stopping operations continue on the 4th level with satisfactory results. Until Seneca is equipped with new hoists in both shafts no further sinking will be done. In the Seneca levels, however, the drifts are extensive and afford ample opportunity for stopping operations and the blocking out of ground preparatory to regular production.

In the Mayflower mine all four drills are now employed in the east cross-cut from the 1700-ft. level. Work has been temporarily abandoned in the west cross-cut.

Mohawk is sinking in No. 4 and 6 shafts and drifting is under way in all four shafts, 1, 4, 5, and 6. Drifting is under way both north and south from the three bottom levels of No. 1. Southward, connection will be made with No. 4 shaft, enabling the extension of the electric haulage system to No. 1. It is the plan of Mohawk to conduct a complete program of sinking and drifting and to keep the mine well opened ahead. Mohawk has a large tract of ground yet to be opened, while many thousands of tons of rock remain in drifts and stopes yet to be widened or enlarged.

Ten men are employed by Calumet & Hecla in development work on the Kearsarge lode east of the 31st level of the Red Jacket shaft. A motor is used to haul the rock to the shaft. A steam-compressor has been employed in furnishing air for the drills but an electrical compressor shortly will be installed, which will cut down the cost of the

work considerably. Only rock of mediocre character has been found to date and the vein is not yet well defined. The formation, however, is to be thoroughly investigated.

MISSOURI

Joplin.—A ruling by Secretary of the Interior Fall is to the effect that new leases on Quapaw mining land "will not be granted until the expiration of existing leases and new regulations governing future leases will be promulgated under the recent Act extending restrictions". This will mean delay in the settlement of sundry disputes over rights in the Picher district. Sub-leases of the Eagle-Picher interests and other mining companies in the district will expire in 1922. In an attempt to renew the leases the Eagle-



Sullivan Mine in the Coeur d'Alene

Picher company made an offer to reduce the royalties to the sub-lessees, from 17½% to 15%, and many of the sub-lessees lent their support, by signing waivers. Most of the sub-lessees, it was said, favored the plan. Others, for various reasons, combined forces against the Eagle-Picher proposal.

MONTANA

Butte.—The Anaconda Copper Co. expects to employ 500 additional men in mining high-grade silver-zinc ore, which will be treated in the company's zinc-plant. It is expected that approximately 150,000 oz. of silver will be produced monthly. Consideration for the employees, who would otherwise be idle, helps account for the decision to resume.—Drifting on the recently discovered copper-bearing vein on the 2050-ft. level of the Butte & Superior mine has disclosed a considerable deposit of ore. A body 20 ft. wide and 100 ft. long, sprinkled with patches of ore, has already been opened.—Ore developments on the 2300-ft. level of the Colorado mine of Davis-Daly are particularly noteworthy, one body showing a width of from five

to six feet of 15% copper ore. Other deposits have been opened on levels above the 2500. It is stated that the ore showing at the present time in Davis-Daly's property is the best in its history. Lessees on the Hesperus vein, operating through the Butte-New England shaft, situated just to the south of the Colorado, are shipping several carloads of ore per week. A good revenue is assured for Davis-Daly from this operation in addition to accomplishing the development of the Hesperus vein in the south-easterly part of the company's territory.

At the Elm Orlu mine recent development discloses a large tonnage of silver ore carrying an average of 20 oz. per ton. Development work now in progress on the 300-ft. level indicates a good tonnage of milling ore. Steps toward raising the new shaft of East Butte to the surface are under way. This new shaft is above the 1200-ft. level and within 800 ft. of the surface. It will place the known orebodies of the East Butte within easy cross-cutting distance.

It is reported that the Norwich vein has been cut on the 400-ft. level by the Butte & Plutus Co. The vein was entered at a point about 325 ft. from the station, disclosing 7 ft. of 12-oz. silver ore. The Butte & Plutus is situated near the Hibernia mines of the Davis-Daly company.

Missoula.—Edward Mayo and associates report good progress in opening the Democratic group of claims in the St. Regis district.

Philipsburg.—The American Gem Syndicate has purchased 250,000 ft. of timber, to be used for making sluice-boxes for its operations in the Flint and Rock Creek districts. During the 1920 season the mines are said to have produced seven tons of sapphires, some of which were cut for rings; by far the largest amount went to watch manufacturers for jewel bearings.

NEVADA

Cow Camp.—Four miners are employed in prospecting the Sanger-Taylor group, on which the original discovery was made. The shaft on this group is 70 ft. deep and to this point assays ranging up to 1000 oz. silver have been obtained, according to Taylor. The district is four miles north-west of Stimler. Many locations have been made in the district and two miles from the Sanger-Taylor ground \$40 gold ore has been found. The vein in the Sanger-Taylor claims has an average width of 6 ft. in the shaft.

Eureka.—The Eureka-Holly Extension Co. has received its new hoist. It will be installed at the collar of the Standard 300-ft. vertical shaft on the Nevada No. 2 claim, where the principal operations of the company will centre. Bad roads have prevented an earlier delivery of this machinery. A cross-cut is being driven from the bottom of the incline near the south end line of the Belle of the West claim for the purpose of establishing the position of the Bullwhacker vein on this ground and its course through the Extension property.—Exploration of the Silver West vein is also in progress. This is one of the strongest veins on the Extension property, showing a five-foot outcrop and a true unbroken course to the north-east through the Nevada No. 4 claim into the Nevada No. 2; apparently making for an intersection with the Holly and Bullwhacker veins near the west end-line of the latter claim.

The Ruby Hill Development company, a New York corporation which late in 1919 optioned the Eureka Consolidated and Richmond mines for a price said at the time to have been \$9,500,000, has relinquished the option, according to reports received here. The company, after cleaning and repairing the Locan shaft to the 1200-ft. point, the bottom, stopped work late in 1920. It had been the intention to sink to 1700 ft. The properties have reverted to the United States Smelting, Refining & Mining Co., owners of more than half the stock, and others.

Goldfield.—The shaft of the Deep Mines is being con-

tinued below the 600-ft. point with two shifts of miners. The funds derived from the recent assessment put the company in financial position to sink to at least 1000 ft., according to H. G. McMahon, secretary for the company. The Red Hill shaft, now 750 ft. deep, will reach the objective, 800 ft., by June 10 and a cross-cut will then be driven 150 ft. to cut the Florence vein system on the north side of the fault.

Hornshyver.—J. W. Dunfee, the lessee, refusing to accept counter-proposals to the original terms made by him, has terminated the option held by the Tonopah Mining Co. on the Orleans mine and the lease held by Dunfee, according to the lessee. The drift in which the find that led to the granting of the option was made has been enlarged at the face until there is now exposed an orebody 7½ ft. wide, 10 ft. high, and assaying more than \$40, according to Dunfee, who says the \$40 figure was obtained from an average sample.

Rochester.—The Rochester Silver Corporation has declared a dividend of 5c. per share, to be paid June 20 to stockholders of record June 15.

Tonopah.—The companies continue to import men in their efforts to break the strike; it now appears certain that they will be successful. Governor Boyle spent several days at Tonopah investigating conditions and attempting to mediate, but he was unable to make progress with the strikers, who on one occasion walked from the hall in which the Governor was to have addressed them following a vote. This vote was against taking a secret ballot on returning to work. The incident of the strikers refusing to hear the Governor turned public sentiment against them to a large extent. It is estimated that only 300 or 400 strikers remain in the town and it is reported that there are among this number many who are anxious to return to work, but who fear the taint of 'scab'. It is becoming increasingly evident that the trouble is going to end in a victory for the companies and that the complete breaking of the strike is merely a matter of time.

Virginia City.—There is much talk of labor trouble when wages are reduced under the agreement between the United Comstock and the Gold Hill miners' union and some of the men already have quit in anticipation. The new scale will be \$5 for miners. Zeb Kendall, president of the Consolidated Virginia and Ophir companies, has succeeded Alex Wise as superintendent. Wise resigned because of ill health following an operation.

SOUTH DAKOTA

Deadwood.—Roy M. Harrop, of Omaha, is here making arrangements to develop the property of the Capital Gold Mining & Milling Co., situated not far from the Trojan mine. Ore assaying \$6 per ton has been found near the surface.

TEXAS

Orla.—Mining and refining of sulphur is about to be started by the Toyah Valley Sulphur Co. whose property is near here. Machinery has been installed upon the sulphur deposit which the company owns and is now being given a test run. Outcroppings of sulphur which have been thoroughly explored cover several thousand acres of land which the company owns. Assays show that the product runs 20% to 97% sulphur. The company is operating under a patented refining process, developed by its secretary, J. A. Daniel.

UTAH

Big Cottonwood Canyon.—Work has been resumed by the Cottonwood Metal Mining Co., under the direction of E. E. Watrous. The face of the adit, now in 1410 ft. from the portal, will be driven until the intersection of the Silver King and Contention fissures is reached.

Eureka.—The Tintic Milling Co. shipped two lots of silver bullion during May, each of which contained about 50,000

oz. of silver, with some gold. The last shipment of copper bullion was in March. The company has a lease on the property of the Swansea Mining Co. and is preparing to mine the large quantities of low-grade ore exposed in that property, principally on the 500-ft. level. A new head-frame has been erected, and the shaft re-timbered to the 400-ft. level. Arrangements for automatic dumping are being made to permit the ore being dumped into cars of the Eureka Hill railway and transported to the milling company's bins.

Shipments from this district for the week ending May 21 totaled 128 carloads, of which the Chief Consolidated shipped 41; Tintic Standard, 41; Eagle & Blue Bell, 11; Dragon, 8; Swansea, 6; Iron Blossom, 5; Iron King, 5; Victoria, 4; Colorado, 4; Alaska, 2; Gemini, 1.

Midvale.—The United States Smelting company has awarded a contract to the Weider-Holt Construction Co. of St. Louis for the construction of a new smoke-stack at its smelter. The stack will be 450 ft. high and will cost \$150,000. It is being erected for the purpose of complying with the recent order of the Federal Court in the 'smelter smoke' case. By using a high stack, the fumes are carried to a level where they are thoroughly diffused so that damage to vegetation near the plant will be entirely eliminated.

Moab.—Howard W. Balsley, of the Yellow Circle Mining Co., has several men at work on the claims near Cane Springs. C. W. Wright, in charge of the work, has a carload of uranium ore ready for market. Several buyers are negotiating for the output. Mr. Balsley has on display here one of the finest specimens of uranium ore ever found in this district. The sample weighs about 15 pounds, and averages 25%.

L. C. Schultz and J. S. James of Denver are in this district in connection with the affairs of the Radium Company of America, which recently took over the Tungsten Products Co. It is understood that the Radium Company is planning the construction of a mill in Dry Valley to handle carnotite ore.

Park City.—Ore shipments from this district for the week ending May 21 totaled 1651 tons, as compared with 1545 tons for the preceding week. The Silver King Coalition shipped 766 tons; Judge allied companies, 467; and the Ontario Silver, 418.

Development work is being done at the property of the Ontario Silver Mining Co. The 400-ft. level has been re-opened to No. 1 shaft and is being continued to the east toward the 'great' fault. Prospecting is also being done on the 1300 and the 1800-ft. levels. The 2000-ft. level has been unwatered, after twenty years. The workings at this depth have been cleaned out and re-timbered, and preparations are being made to tap, from this level, the orebodies developed on the 1800-ft. level.

Salt Lake City.—The Supreme Court of the State of Utah undertook the review of the case of the Utah Copper Co. v. the Utah Power & Light Co. on May 23. The case is of considerable length and somewhat complicated, and involves the authority of the State Public Utilities Commission to interfere with a contract made prior to the creation of the Commission. Since October 22, 1920, the mining company has been billed at practically double the rate provided for by the contract. The difference between the contract rate and the schedule rate between October 22 and March 31 would have amounted to about \$200,000 in the consumer's power bills. R. G. Lucas, attorney for the Utah Copper Co., declared that his company can make power in a steam-electric plant for about 5 mills per kilowatt-hour, as compared with the rate, fixed by the Commission, of more than 8 mills.

WASHINGTON

Colville.—Development work at the Chloride Queen, one of the oldest mines in the district, has been satisfactory.

There is sufficient milling ore in sight in the upper adits to run a concentrator five years or more, but in order to tap the vein at depth work was commenced last December on a lower adit to run 526 ft. to the vein. The Chloride Queen ore assays from \$10 to \$20 per ton. D. E. Zent is directing development.

Keller.—At the property of the Iron Creek Mining Co., 12 miles north-east of here, a new vein has been found that carries 25.4 oz. silver per ton. It has been opened for 15 ft. on the surface and is 1½ ft. wide. Work will commence at once on construction of the foundation for the cyanide plant. The ground is already cleared.

Miles.—J. C. Hammond is driving a tunnel south of, and immediately above, Fort Spokane, where he hopes to cut the Crystal vein, which contains some silver and lead.

Republic.—Lower freight-rates, re-established by the Great Northern railway, will go into effect at once and im-



Tramway at Britannia Mine, Howe Sound, B. C.

mediately some ore shipments will be made. Republic ores are wanted by smelters for their value for fluxing. For this reason they pay a good price for them. It is reported that the Northport Smelting Co. has made a contract to supply the smelter at Trail with 10,000 tons of ore from its mine here. The Northport company is not operating its own smelter and there is no prospect of an early resumption. —Lessees have been working the Knob Hill property and have ore ready to ship.—The San Poil has 3000 tons ready for shipment.

BRITISH COLUMBIA

Alice Arm.—C. B. North, manager for the Taylor Mining Co., arrived from Vancouver, and has gone to the Dolly Varden mine to make a survey of the company's property. Mr. North said he was not able to give any information about the future plans of the company, but he believed much would depend upon his report. If work is re-started, he thought it probable that, for a long time at any rate, it would be confined to development, rather than to production. The main effort during last season was toward production, the intention of the directors being to catch up with the development during the winter, when shipping is impossible.

Barkerville.—The affairs of the Bullion mine are once again in the courts. A writ has been issued by R. T. Ward, on his own behalf and as manager for the Bullion Mining Syndicate, against W. C. Daniels, Stanley P. Dunlevy, and Max McGowan, asking for an injunction to restrain them from trespassing, interfering, or in any way dealing with the plaintiff's interests in the Bullion mine, water-rights, dams, and other property of the syndicate.

Hedley.—G. P. Jones, general manager for the Hedley Gold Mining Co., has returned to Hedley, after an absence of some six months, and is re-opening the Nickel Plate mine. Repairs are being made to the flume, and some slight damage caused by the spring freshets is being mended. At first the operations will be confined to development, which had fallen in arrears in an effort to produce as much gold as possible during the War.

Stewart.—The strike at the Premier mine has been settled, and the men have returned to work at a uniform reduction of 75 cents per day. Miners now are receiving \$5.50, muckers \$5, and laborers from \$4.75 to \$5.—Robert Martin, one of the principal owners in the Mineral Hill group, recently paid a visit to the property for the purpose of arranging for development work on the property during the coming season.—Crawford McGee and R. E. McKechnie, of Vancouver, have arrived to start operations on the Patricia group, on the Marmot river. Some tunneling was done on the property last season, and a considerable body of ore, the extent of which was not determined, running \$12 in gold and \$10 in silver and lead, was discovered. This orebody is to be thoroughly explored this summer.

KOREA

Ulsan.—At the Oriental Consolidated property 160 stamps ran 22½ days during March, crushing 17,235 tons of ore. Gross receipts for the month were \$109,644, with a net profit of \$31,327.

MEXICO

Chihuahua.—Carlos Perez is said to have found radium-bearing mineral, analysis of which has been made in the United States. The mines from which samples have been taken are situated in the Guadalupe district.

Guanajuato.—On May 8, the Governor of the State made public in full the law of Conciliation and Arbitration, which was passed by the State Legislature during the latter part of April. This law affects all employers of labor in the State, but is of particular concern to the mining companies, as they are the largest employers of labor. The following gives a brief outline of the law:

Each municipality is to choose a Board of Conciliation and Arbitration, labor furnishing one member, capital another, and a third member is to be chosen by the municipal government. This board is to attempt to settle disputes and conflicts arising between capital and labor; either side may have it called to a session or it may be called on the initiative of the chief municipal officer of the place, called the 'Presidente'.

In the State capital, a central board will be created, consisting of five members chosen by capital and five chosen by labor and one representing the executive of the State. The members of this board will be chosen for one year and will function permanently; cases that cannot be settled by the municipal boards may be appealed to the Central Board. Both boards will attempt to settle disputes in the shortest possible time; the law specifically states that five days time will be given for the review of the cases brought before the boards. The following penalties will be incurred by the side refusing to abide by the decision of the board:

Article 36. If the employers refuse to carry out the decision of the board they must pay all the laborers engaged in the conflict three months wages, the labor contract being terminated.

Article 37. If the workmen refuse to carry out the decision of the board, their labor-contract is thereby ended and the authorities will take measures necessary to guarantee the employers liberty to make new labor-contracts without having the new laborers molested in the fulfillment of their duties.

Article 45. The owners of mines, reduction works, shops, industrial establishments, and in general all employers of labor, must send to the Central Board for its approval all rules of their establishment each time they are put in force.

Saltillo.—Francisco Salas is to develop the Estrella group of zinc mines in El Aguilerada mountains near Saltillo. The property is near the San Antonio mines which are at present idle on account of the low price of metals and the lack of railroad facilities.

About nine thousand additional mining claims are listed by the Government for forfeiture unless taxes are soon paid. Many of the properties will be re-located by new owners immediately after being declared open for re-filing.

Soyopa.—A discovery of rich gold and silver ore is reported at the Hidalgo mine. Specimens brought to Nogales assayed 157 oz. of silver and ¼ oz. of gold per ton. J. E. Crocker, manager for the Soyopa Silver Mining Co., owner of the property, declares it to be one of the most important finds made for some time in Sonora.

ONTARIO

Elk Lake.—An important discovery of iron ore has been made within fourteen miles of Elk Lake by B. M. Hartley, formerly field man for the Kerr Lake Mining Co., and H. Wescott of Elk Lake. Massive hematite containing 64 to 70% iron appears in one band four feet in width and at least 150 ft. in length; four large dikes, ranging from 17 to 25 ft. in width of quartz and jasper run in a series and the general assay taken showed 55.78% iron, 19.06% silica, and 0.07% phosphorus. The formation is sedimentary, conglomerate and slate being in evidence, and the pebbles in the conglomerate being well-rounded. About 140 lb. of ore was removed; it is almost identical with that of the Gogebic Range in the Lake Superior region.

TORONTO

Porcupine.—The annual report of the Dome Mines for the year ended March 31 shows net profits of \$302,479, as compared with \$951,984 in the previous year, the falling off being due to the difficult conditions under which the industry was carried on by reason of scarcity of labor and power shortage. During the first three months of 1921 costs went up to \$5.03 per ton, while in April when electric power became again available they dropped to \$3.75 per ton. The 273,700 tons of ore milled during the year yielded bullion worth \$1,946,403, the average yield per ton being \$7.11. Dealing with the results of drilling on the 10th level revealing the value of an orebody dipping into the Dome Extension H. P. Depencier, general manager, points out that assays showing \$26 per ton do not represent the average grade of ore that can be expected from that body.—The McIntyre is sinking to the 2000-ft. level from its present workings at 1550 ft. below the surface, the ultimate objective being a depth of 3000 ft., which, however, may require a couple of years to accomplish.—Last year English interests undertook the exploration by diamond-drilling of the sand plains in the neighborhood of the Hollinger. Several drill-holes were put down, but the work was discontinued during the winter and has not been resumed. Americans have recently taken over many of these claims under option and are preparing to drill. The sand lies two to three hundred feet deep over the rock formation into which it is thought some of the Hollinger veins may extend.—The Goldade Mining Co., which has acquired part of the Bewick-Moreing holdings, is arranging to carry on exploration under the supervision of C. A. Poirier of New York.

PERSONAL

The Editor invites members of the profession to send particulars of their work and appointments. The information is interesting to our readers.

W. F. Ferrier, of Toronto, is at Vancouver.

W. H. Whittier is at Barranquilla, Colombia.

H. G. Thiel has left San Francisco for Oklahoma.

Waldemar Lindgren will spend the summer in Bolivia.

E. P. Mathewson sailed from Liverpool for New York on May 25.

J. M. Ruffner, of Atlin, British Columbia, is here for a few days.

J. T. Kavanagh, of Valley, Washington, is at El Dorado, Arkansas.

L. D. Ricketts and John C. Greenway were in New York last week.

Charles R. Davies, of Denver, Colorado, is at Salt Lake City, Utah.

E. A. Knapp, of Redrath, Cornwall, has gone to Maracaibo, Venezuela.

X. B. Stearnes has moved from Morenci, Arizona, to Berkeley, California.

Thomas W. Thompson has moved from Shafter, Texas, to Berkeley, California.

Thomas M. Skinner Jr. has moved from Douglas, Wyoming, to Denver, Colorado.

Carlton D. Hulin has returned from Maracaibo, Venezuela, to Alameda, California.

L. D. Yundt, of Salt Lake City, is now with the Ramshorn Mines Co., at Bayhorse, Idaho.

C. G. Patterson is on his way to Nicaragua, to erect a stamp-mill at the San Albino mine.

C. S. T. Farish has left Mexico, to join the Backus & Johnston company at Casapalca, in Peru.

George H. Garrey, who recently returned from two months in British Columbia, is now at Tonopah, Nevada.

Joseph Irving, of Bisbee, is in charge of leaching experiments for the Dundee-Arizona Copper Co. at Jerome, Arizona.

Gordon Campbell, formerly secretary and treasurer of the New Cornelia Copper Co., has been elected president of the company.

A. W. Newberry returned to New York on May 27 after three weeks spent in visiting Cleveland, Chicago, Washington, and Baltimore.

Arthur Notman, superintendent of the mine department for the Phelps Dodge Corporation, at Bisbee, Arizona, is at Keene Valley, New York.

Veclair C. Smith, mining geologist for the Cia. Mexicana de Petroleo 'El Aguila', S. A., at Tuxpam, Vera Cruz, Mexico, is at Elizabeth, New Jersey.

B. V. Barton, lately at Bendigo, Victoria, has accepted the position of assistant-manager to the Rhodesia Broken Hill Development Co., in Rhodesia.

John Bendel, who has been with the Alaska Juneau Gold Mining Co., at Juneau, Alaska, has gone to Oroya, Peru, with the Cerro de Pasco Copper Corporation.

R. W. Brock, Dean of the University of British Columbia, and J. J. Denny, of the Nipissing mine, have received honorary degrees from Queen's University, Toronto.

Arthur H. Wethey, formerly at Butte, and now residing in Paris, was in San Francisco this week in the interest of the Fund for War Devastated Villages in France.

Frank M. Gallup, of Sandusky, Ohio, is at Crestone, Colorado, convalescing after a bad attack of asthma resulting from influenza, from which he suffered last March.

Charles L. Harrington, field engineer for the Radium Com-

pany of Colorado, has been transferred to Grand Junction, Colorado, where the company has opened new offices.

C. Algernon Moreing, of the firm of Bewick, Moreing & Co., London, has received the Order of the Legion of Honor from the French government on account of his services during the War.

D. D. Moffat, consulting engineer of mills for the Jackling porphyry properties, spent several days in San Francisco recently. He will visit the Chino and Ray properties before returning to Salt Lake City.

Carl J. Trauciman, formerly manager for the Liverpool Silver Mines Co., at Clancy, Montana, is now in the oil-stock department of the Lanzier-Wolcott Co., the Butte correspondents of Logan & Bryan, of New York.

A. H. Lowe, chief geologist for the Mackenzie River Oil Co., has left Edmonton with a party of six men for Peace river, when he will take the first boat to the oilfields at Fort Norman. He plans to stay a year in the North, and will locate sites for the company's boring operations.

M. W. von Bernewitz has completed editing the 1920 proceedings and original papers from the Denver meeting of the American Mining Congress, and is now temporarily engaged with the U. S. Bureau of Mines at Washington, compiling matter to be used by the Bureau in its campaign of technical education in mining regions.

Dorsey A. Lyon, superintendent of stations for the Bureau of Mines, and George S. Rice, the Bureau's chief mining engineer, are to leave Seattle on June 25 for Alaska, where they will investigate conditions in connection with the mining industry generally, and will determine the manner in which the Bureau's station at Fairbanks can best serve the interests of the industry.

Obituary

R. T. Lowery, for many years editor and owner of 'The Ledge', one of the oldest mining papers in British Columbia, died at the Greenwood hospital on May 20, aged 65.

Arthur Lancaster, foreman of the concentrating plant at the United States smelter at Midvale, Utah, was instantly killed on May 21, when his clothing was caught in a fast-revolving shaft and he was crushed before the machinery could be stopped. He had been with the company since the plant was built at Midvale. He is survived by his wife and three children.

Donald W. Cooke, of the U. S. Bureau of Mines station at Berkeley, died suddenly on May 27. He was a native of Washington, served in the army during the War, and since the Armistice was connected with the Bureau of Mines at the University of California, where he was engaged in training miners, boy scouts, and industrial workmen in first-aid and mine-rescue work. He was only 27 years of age.

William Fernie, 84 years old, pioneer prospector, mine operator, and railway promoter, died in Victoria on May 15. The City of Fernie, B. C., was named after him and he was the original discoverer of coal in that district. His first work as a mining man was done in the Australian mines of Bendigo and Perdue. He came to British Columbia in 1860 and was engaged in mining for many years. In 1873 he was appointed Gold Commissioner for Canada, a position he held for four years. On resigning he joined Col. C. Baker and other western Canadians in the effort to obtain a charter for the British Columbian Southern railway. In this he and his confreres were successful, and in 1887 he located the coalfields of the Crow's Nest Pass. With the opening of these fields there grew up in that locality the now flourishing community of Fernie, which, as stated, was so named in honor of the man primarily responsible for its existence.

THE METAL MARKET



METAL PRICES

San Francisco, May 31

Aluminum-dust, cents per pound.....	75
Antimony cents per pound.....	0.75
Copper electrolytic, cents per pound.....	13
Lead, pig, cents per pound.....	5.25—0.25
Platinum, pure, per ounce.....	\$75
Platinum, 10% Iridium, per ounce.....	\$105
Quicksilver, per flask of 75 lb.....	\$50
Spelter, cents per pound.....	7.60
Zinc-dust, cents per pound.....	0.00—9.50

EASTERN METAL MARKET

(By wire from New York)

May 30—Copper is quiet and firm. Lead is inactive and lower. Zinc is dull but easy.

SILVER

Below are given official or ticker quotations for silver in the open market as distinguished from the fixed price obtainable for metal produced, smelted, and refined exclusively within the United States. Under the terms of the Pittman Act such silver will be purchased by the United States Mint at \$1 per ounce, subject to certain small charges which vary slightly but amount to approximately three-eighths of one cent. The equivalent of dollar silver (1000 fine) in British currency is 40.05 pence per ounce (925 fine), calculated at the normal rate of exchange.

Date	New York cents	London pence	Average week ending	Pence
May 24.....	58.00	33.37	Apr. 18.....	60.18
" 25.....	58.12	33.25	" 25.....	60.22
" 26.....	58.00	33.50	May 2.....	60.68
" 27.....	58.00	33.87	" 9.....	61.38
" 28.....	58.62	34.00	" 16.....	60.41
" 29 Sunday.....			" 23.....	58.93
" 30 Holiday.....			" 30.....	58.15

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.	101.12	132.77	05.95	July	100.36	92.01	....
Feb.	101.12	131.27	59.55	Aug.	111.35	90.23	....
Mch.	101.12	125.70	56.08	Sept.	113.92	93.66	....
Apr.	101.12	119.56	59.33	Oct.	119.10	83.48	....
May	107.23	102.69	59.90	Nov.	127.57	77.73	....
June	110.50	90.84	....	Dec.	131.92	64.78	....

COPPER

Prices of electrolytic, in cents per pound.

Date	Average week ending
May 24.....	13.25
" 25.....	13.25
" 26.....	13.25
" 27.....	13.25
" 28.....	13.25
" 29 Sunday.....	13.25
" 30 Holiday.....	13.25

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.	20.43	19.25	12.94	July	20.82	19.00	....
Feb.	17.34	19.05	12.84	Aug.	22.51	19.00	....
Mch.	15.05	18.49	12.20	Sept.	22.10	18.75	....
Apr.	15.23	19.23	12.50	Oct.	21.66	16.53	....
May	15.91	19.05	12.74	Nov.	20.45	14.63	....
June	17.53	19.00	....	Dec.	18.55	13.18	....

LEAD

Lead is quoted in cents per pound. New York delivery.

Date	Average week ending
May 24.....	5.10
" 25.....	5.00
" 26.....	5.00
" 27.....	5.00
" 28.....	5.00
" 29 Sunday.....	5.00
" 30 Holiday.....	5.00

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.	5.00	8.65	4.96	July	5.53	8.63	....
Feb.	5.13	8.88	4.54	Aug.	5.78	9.03	....
Mch.	5.24	9.22	4.06	Sept.	6.02	8.08	....
Apr.	5.05	8.78	4.32	Oct.	6.40	7.28	....
May	5.04	8.55	5.01	Nov.	6.76	6.37	....
June	5.32	8.43	....	Dec.	7.12	4.76	....

TIN

Prices in New York, in cents per pound.

	1919	1920	1921		1919	1920	1921
Jan.	71.50	62.74	35.94	July	70.11	49.29	....
Feb.	72.44	59.87	32.16	Aug.	62.20	47.60	....
Mch.	72.50	61.92	28.87	Sept.	55.79	44.43	....
Apr.	72.50	62.17	30.36	Oct.	54.82	40.47	....
May	72.50	54.99	....	Nov.	54.17	36.97	....
June	71.83	48.33	....	Dec.	54.94	34.12	....

ZINC

Zinc is quoted as spelter, standard Western brands, New York delivery, in cents per pound.

Date	Average week ending
May 24.....	5.25
" 25.....	5.25
" 26.....	5.25
" 27.....	5.25
" 28.....	5.25
" 29 Sunday.....	5.25
" 30 Holiday.....	5.25

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.	7.44	6.56	5.80	July	7.78	8.18	....
Feb.	6.71	6.15	5.34	Aug.	7.81	8.31	....
Mch.	6.53	8.93	5.19	Sept.	7.57	7.84	....
Apr.	6.46	8.76	5.33	Oct.	7.82	7.60	....
May	6.43	8.07	5.37	Nov.	8.12	6.78	....
June	6.91	7.92	....	Dec.	8.60	6.03	....

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, according to quantity. Prices, in dollars per flask of 75 pounds.

Date	1919	1920	1921
May 3.....	50.00	50.00	50.00
" 10.....	50.00	50.00	50.00

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.	103.75	89.00	50.00	July	100.00	88.00	....
Feb.	90.00	81.00	48.75	Aug.	103.00	85.00	....
Mch.	72.80	87.00	45.88	Sept.	102.00	75.00	....
Apr.	73.12	100.69	46.00	Oct.	86.00	71.00	....
May	84.80	87.00	50.00	Nov.	78.00	58.00	....
June	64.40	85.00	....	Dec.	95.00	52.50	....

DECLINE IN COMMODITY PRICES

Recent increases in the wholesale prices of certain commodities do not indicate a new period of rising values, in the opinion of Herbert P. Howell, vice-president of the National Bank of Commerce in New York. They do, however, show that the violent general decline in raw materials is definitely at an end. Many individual commodities will show considerable further revisions, he believes, but the general movement has reached a level at which manufacturers may do business on the basis of their own requirements irrespective of the market prices of unrelated commodities.

"Of the 26 representative commodities quoted monthly by the National Bank of Commerce in New York in its magazine, 'Commerce Monthly,' Mr. Howell points out, 'sixteen showed increases in May over the preceding month, while four stood still, and only six continued to decline.'

"These increases must not be construed as indicating a new period of rising prices. Some of them are seasonal in character and others reflect a tendency toward stabilization on the part of commodities which in the general decline that began in the spring of 1920 may have fallen below a fair valuation. The increases are important, however, because they demonstrate that the process of liquidation has reached a point where raw materials are beginning to react to conditions in their own individual markets.

"Normally the price movement of every commodity is determined primarily by the status of its own market and that of commodities immediately related to it. Only in boom periods or during violent depressions are prices affected more by the general movement than by these individual factors. What has happened now is a return toward normal conditions. Henceforth, commodities may be expected to fluctuate in obedience to the influences of specific supply and demand.

"Many prices have stabilized. This does not mean that there will not be further declines. They may be expected in many lines, and commodities which have not yet been adjusted will receive no support from others that have reached a stable footing. In their decline, they will not force down commodities in which deflation has already occurred.

"Index numbers have not yet disclosed the end of the general price-change in the market for raw materials, due to the fact that all such numbers in use contain quotations for a large number of commodities in fairly advanced stages of manufacture and in some cases ready for consumption. There is a considerable lag between declines in raw materials and in finished goods, and when quotations from these two groups are combined the declines in manufactured goods are sufficient to obscure the trend of basic material prices.

"While the violent general decline in raw materials and related products is over, this does not preclude a slow decline for a period of years. Such a decline would be no menace to sound business. It is perfectly possible in such a period to carry on sound manufacturing and merchandising operations with profit. Gradually falling prices over a period of years would not materially affect the price-movement of commodities over such periods as are usually necessary for these operations. The present generation of American business men has been unduly alarmed by the downward tendencies of prices. Rising prices are not necessary to prosperity, and a slow downward movement is discouraging only to reckless speculative activities."

MONEY AND EXCHANGE

Foreign quotations on May 31 are as follows:

Sterling, dollars:	Cable	3.88 1/4
	Demand	3.89 1/2
Francs, cents:	Cable	8.37
	Demand	8.39
Lire, cents:	Demand	5.30
Marks, cents		1.05

Eastern Metal Market

New York, May 25.

All the markets are quiet except copper; it is more active and by far the strongest.

Foreign buying of copper continues and prices are higher.

The tin market is quiet and without feature.

Demand for lead has lessened and the market tone is easier.

The zinc market continues lifeless and prices have declined a few points.

IRON AND STEEL

The further slowing down of operations at iron and steel plants, as well as of new buying, has dispelled any hope recently entertained of an immediate turn for the better, according to 'The Iron Age'. In the industry attention is centring upon the reduction in railroad wages, ranging from 10 to 15%, effective July 1, as making possible the lower freights which are now expected to bring such further readjustment in iron and steel prices as will start business. Opinion is uniform that freight-rates are coming down, but the belief that this may be some months hence points to light buying of steel products meanwhile, as no stock will be accumulated on today's prices. Meanwhile, the railroad-wage reductions are regarded as a favorable factor, in view of the easier financial condition of the railroads in the second half of the year. The failure of many railroads to pay their steel bills has tightened the finances of not a few mills.

COPPER

There are reports that buying of copper for export last week totaled 25,000,000 lb., but it has not been possible to confirm this. There is no doubt, however, but that foreign buying by all the leading countries of Europe and the Far East has been heavy and perhaps heavier than a week ago. Domestic business is better, but by no means active. Prices have stiffened at least $\frac{1}{2}$ ¢. per pound and in some quarters more than this. The minimum on electrolytic copper for June delivery is 13.50¢., delivered, with some asking 13.75 and 14¢., delivered. Foreign sales are in most cases made at $\frac{1}{2}$ to 1¢. higher. Lake copper is also higher at 13.25¢., New York, or 13.50¢., delivered. Export demand is so good that foreign agents of American sellers are being limited as to the amount they can sell. Both the Export Association and outside sellers have participated liberally in foreign sales, some saying that England has been a good buyer; others that France, Germany, and others are their chief customers. The market tone is strong.

TIN

The market has been practically inactive excepting one day—on last Thursday, May 19, about 150 to 200 tons of future shipment and spot Straits tin was sold at around 33¢. for both positions. The only other feature was the slump in exchange in London on Monday, May 23, which lowered values of tin here as well as there. The decline in sterling is ascribed to the Silesian matter. Yesterday values in London fell about £3 per ton from Monday's level, with spot standard quoted yesterday at £181, future standard at £181 10s. and spot Straits at £185 per ton. These values, however, are not much below those a week ago today. After hanging at 33 to 33.25¢., New York, spot Straits fell Monday to 32.75¢. and yesterday to 32.25¢., New York, sales having been light. Arrivals thus far this month have been 815 tons with the quantity afloat reported as 2075 tons.

LEAD

Buying has subsided and a little easier tendency has developed, the market being quiet and dull and without any

feature. The American Smelting & Refining Co. has not changed its quotation of 5¢., New York and St. Louis, but in the outside market values are lower at 4.80¢., St. Louis, or 5.10¢., New York, which we quote as the market, most business going at these prices. The relation between consumption and production may have changed recently because at 5¢. it would pay to produce, and a resumption in some cases has probably taken place.

ZINC

Softness continues to develop in the market for prime Western, which today is quoted at 4.75¢., St. Louis, or 5.25¢., New York, for early delivery. Demand is confined to small lots here and there for hand-to-mouth needs. Several large sellers will not quote at present levels and prices for forward delivery are practically unobtainable. Germany has been supplying most of the needs of England in recent months, which has cut down American export demand, but the importation of an export tax in Germany may change this condition in favor of American zinc.

ANTIMONY

The market is quiet and without change, with wholesale lots for early delivery quoted at 5.25¢., New York, duty paid.

ALUMINUM

Wholesale lots of virgin metal, 98 to 99% pure, for early delivery are quoted by the leading producer at 28¢. f.o.b. plant, while the same grades from foreign makers are easier at 22.50 to 23¢.

ORES

Tungsten: No decided change is reported. Buyers' and sellers' ideas of prices do not harmonize and therefore inquiries, which are moderate in volume, do not result in much business. Quotations range from \$3.25 to \$4 per unit.

Ferro-tungsten is quoted lower at 48 to 58¢. per pound of contained tungsten in lump form guaranteed.

Molybdenum: No demand is reported and quotations are nominally unchanged at 45 to 50¢. per pound of MoS₂ in regular concentrate.

Manganese: Stocks are heavy and importations very large on contract, so no business develops. Quotations are nominal at 22.50¢. per unit, seaboard, for high-grade foreign ore.

Manganese-Iron Alloys: Demand for ferro-manganese is confined to a few carload lots. Quotations are \$80, delivered, for the American product and \$75, Atlantic port, for the British. Spiegeleisen is quiet at \$30 to \$32, furnace.

Manufacturers must be prepared to meet the cry for lower prices, states the 'Electrical World,' not necessarily because their prices are unduly high, but because other commodities, which have hitherto been out of reach, are beginning to approach normal. The public is inclined to believe that all manufacturers have profiteered, and the burden of proof therefore will be thrust on the producer. Unreasonable demands will be made on the industry, and these will have to be dealt with sympathetically but firmly. If it is possible to grant reductions or better terms, these should be given, and if business can be re-started by taking some losses, it may be the part of wisdom to bear them. But it is shortsighted to put artificial props under trade and industry in an effort to prevent readjustment. It will also avail nothing to offer goods at cost or less if there are no takers.

Current Prices of Commodities

The figures given on this page represent the regular current price, at the time of our going to press, to industrial buyers of standard commodities in small wholesale lots on San Francisco Bay. They should not be construed as being quotations nor as being either the lowest or the highest price; they are given rather as a guide by which to follow the trend of the market or to estimate the approximate cost of materials and supplies.

CHEMICALS AND ASSAYERS' SUPPLIES

Acid, sulphuric, com'l 66 $\frac{1}{2}$, in drums, per 100 lb.	1.50 to 2.00
" " " " carboys " "	2.00 to 3.10
" " " C P, 9 lb. bottles, in barrels, per pound.	0.27
" " " bulk in carboys per pound.	0.22
" muriatic, com'l, in carboys, per 100 lb.	2.75 to 3.25
" " C P, 6-lb. bottle, in barrels, per pound.	0.32
" " " bulk in carboys per pound.	0.25
" nitric, com'l, in carboys, per 100 lb.	9.00 to 9.60
" " C P, 7-lb. bottles, in barrels, per pound.	0.39
" " " bulk, in carboys, per pound.	0.32
Argols, ground, in barrels, per pound.	0.14
Borax, cryst. and conc. bags, per 100 lb.	5.50 to 6.50
" powdered, in barrels	5.75 to 6.40
" glass, ground, 30 mesh, cases, tin lined, per 100 lb.	18.50
Bone ash, 60 to 80 mesh, in barrels, per 100 lb.	8.50
Cyanide, sodium, 96 to 98%, 100-lb. drums, per pound.	0.31
Lead acetate, brown, broken casks, per 100 lb.	18.50
" " white " "	19.00
" " " crystals, per pound.	0.20
" C P, test., granulated, per 100 lb.	17.50
" " sheet per 100 lb.	14.50
Litharge, C. P., silver-free, per 100 lb.	15.50
" com'l, per 100 lb.	12.50
Manganese oxide, bulk, imported in barrels, per ton.	80.00
Manganese di-oxide, bulk, Caucasian (85% MnO ₂ - $\frac{1}{2}$ % Fe), in casks, per ton	140.00
Potassium nitrate, double ref'd., small cryst., in barrels, per pound	0.18 $\frac{1}{4}$
" " " " granular " "	0.18 $\frac{1}{4}$
" " " " powdered " "	0.19
" carbonate, calcined, in barrel lots, per lb.	0.25
" permanganate, in drums, per pound.	0.70
Silica, powdered, in bags, per pound.	0.03
Soda, carbonate of (ash), in barrels, per 100 lb.	3.50
" bicarbonate of " "	4.00
" caustic, ground, 98% " "	0.50
" " solid " "	5.00

ELECTRICAL SUPPLIES

Armored copper cable, size 8, BXL 3, lead and armor, 100-ft. lots per 1000 ft.	700.00
Armored copper cable, size 8, BX 3, armor, 100-ft. lots, per 1000 ft.	393.00
Conduit, galvanized iron, $\frac{3}{4}$ in., per 100 ft.	12.40
" " " 2-in. " "	39.20
Copper wire, size 0, bare, 200 to 1000-lb. lots, per 100 lb.	19.45
" " " 10, triple-braid, weather-proof, coil lots, per 100 lb.	23.00
" " " 14, single-braid, rubber-covered " per 1000 lb.	8.00
Insulators, glass for telephone, No. 9 pony, per 1000.	80.50
" " " power, No. 14, per 1000.	103.00
" " " porcelain, 6600 v., No. 44, per 100.	21.50
Porcelain knobs, No. 5 $\frac{1}{2}$, 10d. 'nailit', per 1000.	34.25
" " " " solid, per 1000.	20.00
" " " 3 $\frac{1}{2}$ " "	64.50
" " " tubes, 5/16 by 3-in. " "	11.65
" " " $\frac{1}{2}$ " 6-in. " "	42.15
Sockets, weather proof, molded, No. 60,666, per 100.	31.20
Telephone wire, iron, size 12, half-mile lots, per 100 lb.	10.25

EXPLOSIVES

Blasting-caps, No. 6, in lots of 5000, per 1000.	18.80
" " electric, 6-ft., No. 6, in lots of 1000, per box of 100.	0.30
Blasting-powder, "B" soda, in 100-kg. lots, per keg of 25 lb.	2.20
Dynamite, nitro-glycerine, 40%, in ton lots, per 100 lb.	20.50
" " gelatine " "	21.50
" " ammonia " "	19.50
Fuse, common, in case lots, per 1000 ft.	8.50
" " waterproof, triple tape, in case lots, per 1000 ft.	10.54

FUELS

Coal, Utah steam, \$4 at mine, plus \$7.50 freight to California terminal points, in carload lots, per ton.	11.50
Coal blacksmith's, in carload lots, per ton.	24.00
" " " in small lots, per ton.	27.00
Coke, in carload lots, per ton.	26.00
Fuel oil, per barrel.	1.75
Diesel oil, per gallon.	0.06 $\frac{1}{2}$
Distillate " "	0.16 $\frac{1}{2}$
Gasoline " "	0.24 $\frac{1}{4}$

HARDWARE

Anti-friction metal, per pound.	0.24
Babbitt, genuine " "	0.54
Brass sheets, half-hard and soft, per pound.	0.30
Drill-steel, hollow, first grade, in ton lots, per pound.	0.18
" " solid " "	0.11
Fish-plate bolts, $\frac{3}{8}$ by 2-in., per 100 lb.	9.30

Nails and spikes (20d to 60d base) per keg	5.25
Nuts, hot pressed $\frac{3}{4}$ in., hexagonal, per 100 lb.	11.25
" " cold punched " "	13.20
Picks mining 5 lb. per dozen.	12.00
Shovels, carbon steel, No. 2, long handles, per dozen.	18.00
Track spikes, per 100 lb.	0.10

HEAVY STEEL AND PIPE

Bar steel, soft, per 100 lb.	4.35
Rails, steel, 8 to 25 lb., per 100 lb.	4.60
Reinforcing steel, per 100 lb.	4.35
Sheets, corrugated, galvanized iron, 20 gauge, per 100 lb.	7.80
" " flat " "	7.70
" " flat, black iron " "	6.00
Structural T's channels, angles, and beams " "	4.35
A deduction of 15c. per 100 lb. is made on the above when purchased in carload lots	
Bars, steel, square, cold-rolled, per 100 lb.	7.50
Pipe, wrought iron, black, standard, 1 $\frac{1}{2}$ in., per 100 ft.	13.80
" " " galvanized " "	17.20
" " " black " 4 in. " "	61.05
" " " " extra strong " "	116.75
Shafting, cold-rolled (2 $\frac{3}{4}$ to 3-in. base) " "	0.25

HOISTING-ROPE

Discounts for delivery from Pacific Coast stocks are: east steel, 17 $\frac{1}{2}$ %; extra strong east steel, 25%; plow steel, 30%; blue-centre steel, 15%. The following illustrations indicate the net price for each kind of rope, in standard, 6-strand, 19-wire, 1-in. rope	
Blue-centre rope, per foot.	0.42 $\frac{1}{4}$
Cast-steel rope, per foot.	0.25 $\frac{1}{4}$
" " extra strong, per foot.	0.28
Plow-steel rope, per foot.	0.30

LUMBER

The figures given are subject to variation, depending upon the size and length. A charge for cartage is also to be added. Prices are furnished by Van Arsdale, Harris Co.	
Fir, No. 2 clear and better, 1 to 2 in. thick, up to 16 in. wide, per thousand feet (M)	90.00
Fir, common, base price, per M.	30.00
Fir, common, 6 by 6-in. up to 12 by 12-in., per M.	30.00
Redwood, rough merchantable, 1 to 4 in. thick, per M.	50.00
" " clear, 1 to 2 in. thick, up to 12 in. wide, per M.	100.00
Spruce, 'B' and better, 1 to 2 in. thick, up to 16 in. wide, per M.	90.00
Sugar-pine, No. 1 and 2 clear, 2 in. thick, up to 16 in. wide, per M.	200.00
White pine " "	180.00

MISCELLANEOUS

Air-hose, 1-in., 5-ply, plain, per foot.	0.48 to 0.65
Candles, 'Granite' mining, 6-16-40, 10-case lots, per case.	7.10
Carbide, in 100-lb. cans, per can.	7.75
Cotton waste, best grade, per 100 lb.	16.25
Diamonds for drilling, according to size, per carat.	50.00 to 75.00
Manila rope, grade 1, per pound.	0.19
" " " 2 (standard), per pound.	0.18
Packing, flax, per pound.	0.50 to 1.00
" " sheet " "	0.35 to 1.00
" " steam or water, first grade, per pound.	1.00
Silix lining, crated, per long ton.	35.00
Tube-mill pebbles, Danish, selected (in bags), per long ton.	30.00
Zinc-dust, in 250-lb. boxes, per 100 lb.	9.50
" " sheet, 36 in. by 84 in., in tons lots, per 100 lb.	14.50

PORTLAND CEMENT, LIME, ETC.

Fire brick, clay, per 1000, in carload lots.	60.70
Fire-clay, in bags, per ton.	18.00
Lime, lump in barrels, per barrel of 180 lb.	3.25
Portland cement, in bags, per barrel of 380 lb.	4.20
Allowance of 15c. for bags returned in good condition.	
Portland cement, in barrels, per barrel of 400 lb.	5.50
A deduction of 50c. per barrel is made on lime and cement when sold in carload lots.	

ORES AND MINERALS

The following prices represent approximately what can be obtained for the products indicated delivered at points on San Francisco Bay. These, of course, vary widely with the grade and purity of the ores. The present stagnant condition of the market makes many of the quotations purely nominal; most of the ores can be purchased at these prices, but it should be understood that it is not easy for the producer to market them at this time. This list is corrected monthly by Atkins, Kroll & Co.	
Antimony ore, approximately free of lead and arsenic, not less than 50% Sb. per %	
Asbestos (crysotile), according to length of fibre, per ton.	\$20 to \$2500
Barite, white and free of iron (crude), per ton.	5 to 10
Bismuth ore, not less than 20% Bi, per % Bi.	12
Feldspar, crude, lump, free of iron, per ton.	5 to 10
Fluorspar, 85% calcium fluoride, per ton.	15 to 20
Fuller's earth, ground to pass 80 mesh, per ton.	5 to 10
Graphite, crystalline, per pound.	3c. to 7c.
Magnetite, calcined, per ton.	25 to 35
Manganese ore, less than 0.75% Fe; less than 6% SiO ₂ , per ton	25 to 30
Mica, according to size, clearness, and cleavage, per pound.	1 to 8
Molybdenite, not less than 85% free of copper, per % MoS ₂ .	8 to 12
Ochre, according to strength, crude, per ton.	8 to 15
Sulphur, 99.5% pure, only trace of As and Se, per ton.	15 to 18
Talc, lump, white, per ton.	7.50 to 10
Tin ore, not less than 60% Sn, per % Sn.	5
Tungsten ore, not less than 65% WO ₃ , per % WO ₃ .	2.75 to 3.00



T. A. RICKARD, - - - Editor

IN OUR news columns will be found a summary of the report of the Committee on Revision of the Mining Law that was submitted recently to the Director of the Bureau of Mines. This report is to be the basis for a proposed new code of mining law. The complete report, together with editorial comment, will appear in a later issue.

GOVERNMENT appointments on a non-political basis are so entirely desirable that we welcome the Bill, recently introduced by Representative McFadden, that has for its purpose the creation of a permanent Under-Secretary of the Treasury and the abolition of the office of Comptroller of the Currency. The new Under-Secretary would receive additional emoluments, commensurate with his position as a trained man and as an authority on finance and taxation.

IN reviewing the trend and maintenance of high prices during recent years it is interesting to refer to an exception to the general tendency, in the case of oxygen. The use of this gas has increased so largely during and since the War that scope has been found by the principal producers for improvement in the manufacture and for cheapening the production; the result being that the cost to the consumer has been lower during the intervening time than it was in 1915. To this fact is due, in no small measure, the increased use of a combination of oxygen and acetylene for welding and cutting metals, and the extension of the application of the oxy-acetylene torch to all phases of engineering work.

FROM Gowganda, a mining district of promise in Northern Ontario that suffers from the lack of railway communication, comes the novel suggestion that a satisfactory substitute for a railroad might be a track of light steel rails on which motor-trucks could be operated economically. Mine operators have urged the Provincial government to extend the Elk Lake branch railway to Gowganda, but such a project is not warranted at the present time, according to the officials. The recent suggestion is that the Government be approached with a proposal that it help to finance the laying of light rails suitable for motor-truck traffic. We are not familiar with local conditions and do not know, therefore, what obstacles there may be to interfere with efficient transportation by truck on an ordinary high-

way. Apparently an opportunity for an interesting comparison offers itself to auto-motive engineers to determine the comparative economy of the two systems, taking into account such factors as first cost, maintenance, depreciation, and operation.

DECLINES in the cost of production and manufacture are not felt by the consumer until some time after they have occurred. The wholesale prices of commodities are declining slowly but steadily; the Bureau of Labor Statistics reports a drop of 5% in April, as compared with March. The April 'index' figure is nearly 42% below that of April 1920, and nearly 43½% below the peak of last May. The same Bureau states that the retail cost of food to the average family in the United States during April was 2.7% less than it was during March. However slow the reduction in the cost of living may be, a further steady decline is inevitable. With the approach of 'normalcy' the law of supply and demand will affect, if not control, the situation.

JUNE 1 was the date set for the reduction of prices by the manufacturers of many commodities; our friends in the 'powder trust' joined the procession by reducing the price of explosives by about 10%. This will be good news to the miners, who have cherished a particular grievance because powder has heretofore cost them almost as much as it did during the War. To give the devil his due, however, it may be mentioned that the war-price of explosives was not as high, in proportion, as that of sundry other necessities. Nevertheless the manufacturers of powder reaped plentiful profits when the cost of labor and raw materials was two or three times what it is today; it is evident therefore that the recent reductions were in order, and that a still further readjustment downward ought to be forthcoming later.

OF the many towns affected by the recent shut-down of the copper mines, perhaps none is more interesting than Tyrone, New Mexico, where the Burro Mountain mine and concentrator of the Phelps Dodge Corporation are situated; nor has any suffered more seriously from the suspension of operations. As a mining camp Tyrone is unique. A touch of romance is lent by the fact that Mrs. Cleveland H. Dodge was godmother to the town; it was largely through her influence that

attractive bungalows were built as miners' homes. The 'shanty town' that mars the appearance of most Western mining settlements is lacking. The company houses are not built from a standard pattern, but each is artistically designed to follow the southern Californian type of architecture; the railroad station is said to be the most beautiful in the State. Here a few months ago 4500 busy people led contented and thrifty lives; now only the watchmen and their families remain. The homes are deserted; the general store owned by the Phelps Dodge company is closed and its stock has been shipped to Bisbee; the great power-plant, the mill, the compressors, and the hoists are pathetically silent; even the railroad company has announced that train service on the branch line to the Santa Fe will be discontinued. May the time be short before the whistle that calls the miners to work is again blowing regularly, and the bungalows of Tyrone are buzzing with the voices of happy children!

COMPLAINT is often voiced, by those of us whose professional work takes us abroad, that we do not get adequate or satisfactory assistance from our consular representatives. This may be due, in no small measure, to our own faults; it is certain, however, that a reciprocal interest will help to quicken the mutual feeling that should arise between a stranger to, or a foreigner in, a country, and his country's representative. The Mining & Metallurgical Society of America is doing a service in asking its members to communicate with the secretary in regard to intended professional visits abroad; the Secretary of State will then be advised, and this information will be passed, through official channels, to the consular and diplomatic representatives in the districts to which the engineer intends to go. This will be of mutual benefit. The engineer will possess satisfactory introductions; the plan will enable the Department of State to keep in touch with professional men who can be of service to the Government's representatives in foreign countries. The personal contact will engender a degree of mutual respect and co-operation that is now somewhat lacking.

OPINIONS differ as to the results of decreasing the number of working hours in a week. In some instances a marked increase in efficiency is reported; in others, the reverse. The National Industrial Conference Board has recently issued a report that deals with the results of an extensive investigation of conditions in 436 manufacturing establishments in which, since the beginning of 1919, the weekly schedule of working hours has been reduced to 48 per week, or less. The number of workers included in the investigation was 373,536; a variety of industries was represented, some small, some large. In 87.2% of the establishments a reduction to a work-week of 48 hours or less was accompanied by a decrease in the weekly output per worker; in 8.7% of the plants the workers maintained weekly production; in a very few cases (4.1%) the weekly output per worker was increased. It was found that, in those industries where highly automatic production predominated, the output

was governed almost entirely by the speed of the machine, as might be expected. In other industries, where hand-work predominated or where the skill and speed of the worker in handling machines were the controlling factors, it was possible to increase the output in some cases to the extent of entirely compensating for the loss in work-time by the substitution of shorter hours.

AN interesting feature of the new plant, of 200 tons daily capacity, at the Luz mines of the Guanajuato Reduction & Mines Company, which was completed during December last, is the large amount of concrete that was used. The mill, according to the annual report, is of the all-sliding type. The ore is broken in rock-crushers, and then passes to a battery of 25 stamps, each of 1150 pounds. The pulp is further reduced in a 5 by 5-foot ball-mill, and finally slined in three 5 by 16-foot tube-mills that operate in closed circuit with Dorr classifiers. Five 36 by 10-foot Dorr thickeners are used, in conjunction with diaphragm pumps, for the impoverishment of the pulp by a system of counter-current decantation, the agitation of the pulp and the dissolution of the metals being effected in four 36 by 12-foot Dorr agitators. The surplus solution from the tailing pond is pumped back to the plant circuit. The Merrill-Crowe system is used to precipitate the gold and silver from the cyanide solution. Reinforced concrete has been used throughout the cyanide plant—for the construction of the thickeners, of the agitators, and of the storage vats. In some cases it was found possible to utilize the upper sides of the vats as retaining walls, thus effecting a saving of construction expense; the substitution of concrete for steel resulted in halving the cost of the vats. The material has given complete satisfaction; the plant is in successful operation, and detailed results of actual practice will be awaited with interest.

Prospecting

The invitation, conveyed in our issue of April 23, to our friends the prospectors to 'chip in' with contributions to the discussion of this subject has been accepted by many of them in the most excellent spirit. We have published a number of letters. It will be noted that there is general agreement on two points: that the gambling in cheap mining stocks has diverted the money heretofore available for prospecting, and that the suspension of assessment work on mining claims has alienated a large part of the public domain that might invite exploration on the part of real prospectors. In our issue of May 21, Mr. W. K. Whitmore objects to the suspension of assessment work; a week later Mr. Francis O'Boyle makes the same 'kick'; so does Mr. E. C. Watson. We agree with them; the urge for excusing locators from doing work on their claims comes not from the genuine prospectors, who want to explore, but from those who desire to hold claims while their neighbors prove the character and extension of the veins or lodes in immediately adjacent ground and thereby give some sort of value, fictitious or real, to their locations.

The other conclusion, that prospecting suffers from wild-cat promotions and the gambling in cheap stocks, finds even stronger support. The "fake mining companies", as Mr. E. M. West calls them, absorb the money that the local storekeepers and others used to put into grubstakes; the public, even in the vicinity of mines, prefers to dabble in 10-cent shares rather than to subscribe the working capital that is needed for a small mining adventure led by a reliable prospector of the old-fashioned type. Mr. F. W. Wright asserts that the former backers of the prospector are taking longer chances of buying stock on a margin, in preference to backing the real search for ore. With this view likewise we are in sympathy; too many people regard mines merely as counters in a gamble; they seem to think that "mining" consists in digging into the pockets of other people, and that "milling" is the concentration of currency from the pockets of the many into the coffers of the few. Mining is the making of money by the exploitation of ore deposits; it is not the deception of simpletons or the trapping of the unwary. The stock-exchanges have a function to perform, of course, but an enormous amount of capital and of human effort is wasted on them; we do not blame the genuine prospector for feeling sore that he is neglected while the wild-cat promoter wins such frenzied support. A great economic waste is apparent, and all the talk about the need for exciting public interest in the mining "game", as a means for raising the money expended in actual mining operations, will not obscure this fact, to which our friends the prospectors point, not without bitterness. Undoubtedly if only a small part of the money that the public spends on Bush street, on State street, or on Wall street, were made available for systematic and intelligent exploration in the mountains and deserts of the West, there would be found much new ground upon which profitable mining could be conducted. We agree with Mr. William Crocker that there is a lamentable waste of money and labor in assessment work; much of it is done without any idea of its proving useful; it is perfunctory and is done to meet the legal requirement. Mr. S. L. Perini suggests the organization of a prospectors' bureau, for the purpose of giving technical and other advice to the men in the field. We venture to suggest that if the annual dues on a location were payable, at the owner's option, in cash instead of supposed work, it might be practicable to collect a large sum of money for the purpose of assisting prospecting by means of a bureau of information, or by building roads, providing ore-testing facilities, or doing other things directly helpful to those engaged in prospecting. The genuine prospector might still prefer to do his assessment work by personal labor; but others, not miners, might be permitted to pay a part or all of the \$100 to a fund such as we have indicated. Thus a large reserve of capital would be accumulated for the purpose of stimulating the search for new ore deposits. At present millions of dollars are frittered away or simply wasted in nominal labor without any real purpose and of no actual usefulness.

Some direct contributions of information on the art

of prospecting have been made. Mr. Crocker outlines a plan of action and gives sundry useful hints, based upon his personal experience in Central Africa and elsewhere. Mr. S. A. Knapp describes the methods he found successful in Nevada. His plan of "pocket hunting", as he says, is an extension of the old Cornish practice of "costeaning", and his description constitutes a real gain to the literature of the subject. As for the prejudice expressed by sundry prospectors against the mining engineer, we understand it, just as we understand the similar prejudice of many mining engineers against a certain type of prospector. There are small-minded men in both professions, for a genuine prospector is a professional man no less than the engineer. The best of those engaged in either calling have a high regard for the other, based upon mutual understanding and appreciation of the work each performs. This leads to intelligent co-operation, which, of course, is what is needed for the extension of profitable mining activity. Such discussions as the one we are reviewing will help to promote the goodwill and sympathy that are needed for the promotion of the best interests of the mining industry.

Professional Advice From the Bureau of Mines

Our Eastern contemporary, the "Engineering and Mining Journal", draws attention to a report that was recently published by the Bureau of Mines, written by a Bureau metallurgist, and dealing with the treatment of goldbearing tailing from an Alaskan mill. Objection is made by the "Journal" that the Bureau has committed a breach of etiquette in failing to observe the recognized line of demarcation between its own legitimate activities and those of a professional practising engineer. The rebuke is pertinent and timely; but we do not agree entirely with the tenor of the criticism. "The report", it is said, "is suspiciously like many we have seen over the signatures of practising metallurgists . . . we feel that the Bureau is treading on dangerous ground both in carrying out testing work which is distinctly an encroachment upon professional practice and in spreading a report which might lead others to believe that the Bureau's research work has descended into the category of the side room of the assayer's shop." An unhappy comparison is suggested between the work of practising engineers and the "Bureau's accomplishments in the broader fields of research". However undesirable and improper such a proceeding may be, we are disinclined to believe that the Bureau's labors would necessarily suffer a decrease in dignity if its officials were to encroach on the domain of the practising engineer. If the "Journal" meant to say that the report under consideration was a joke, then we agree. It is to this phase of the question that we invite attention, in the hope of warning mine operators that, should they call in Bureau of Mines engineers for professional advice, they must not place too much reliance on the result.

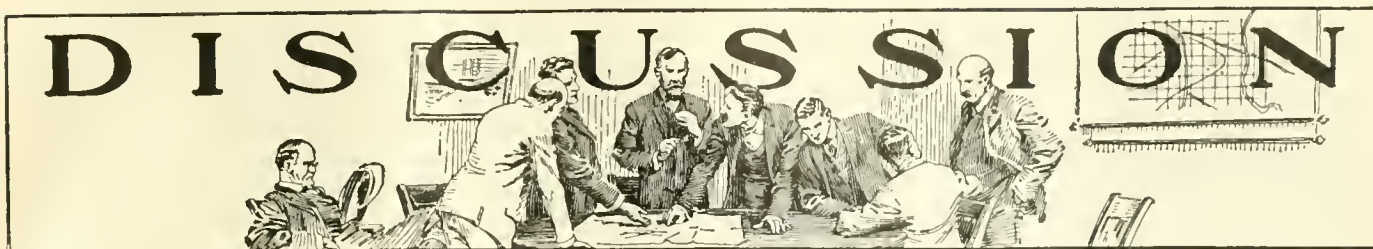
The report was for the purpose of suggesting a suit-

able procedure to a company operating in Alaska that had treated a comparatively small quantity of oxidized gold ore by amalgamation. The tailing was available for experimentation. For some inexplicable reason no leaching tests seem to have been made on the mixed material. The report shows that 65½ pounds was taken for a concentration test, from which four products were obtained: concentrate, middling, sand, and slime. Only about 2½ pounds of concentrate resulted; but this fact did not deter the official from making a complete series of tests in bottles. Two pounds of cyanide per ton of solution and 10 pounds of lime per ton of tailing were used. The ratio of solution to ore is not mentioned. The result, after periods of agitation varying from three to five days, was that a "satisfactory extraction" was obtained from all the table products. The report states that the cyanidation of concentrate is only feasible on material obtained from oxidized ore, and that high extractions cannot be expected from a sulphide concentrate. This shows either an entire ignorance or an utter disregard of the literature on the subject. An outline of the proposed plant is then given. It is to consist of a concentrating table, two 40-ton leaching vats (each 16 by 5 feet), precipitating plant, sump-tank, centrifugal pump, and the necessary piping. The flow-sheet shows that the amalgamation tailing will pass over a table of the Wilfley type, yielding a concentrate, a sand, and a slime. A clean concentrate from a sulphide ore could be shipped, we are told; whereas the concentrate from an oxidized ore should be cyanided. The sand, which represents all the tailing except the slime, is to be leached with cyanide solution. The slime is sent to a pond, to be reserved for future treatment, or a concentrate is obtained by flotation. A total cost of \$1.80 per ton of sand treated is estimated; and it is anticipated that the capital invested would be returned after twelve months' operation, provided "the ore blocked out in the mine warrants the assumption that 3000 tons of \$40 ore can be mined and milled".

A practising engineer would detect several serious flaws in the Bureau engineer's work and conclusions. In the first place, the concentrate produced contained only 11.2% of the gold in 3.7% of the weight of the original tailing. The 'value' of the concentrate is given as \$22.48 per ton, as compared with a 'value' of \$7.21 per ton for the original tailing. The operator is told that if it comes from an oxidized ore it must be cyanided, but he is not told how to do it. According to the results obtained, only about 750 pounds of concentrate would be produced per 24 hours. If he is to re-grind it, then additional plant is necessary; if re-grinding is not to be advocated, then why the concentration in the first instance? A five-day cyanide treatment showed an extraction of 88.4% of the gold in the concentrate. No apparent justification exists for the isolation of this material, or for the expense involved in the purchase of concentrating equipment. The recommendations include the provision of two leaching vats, each of which would require six days to be filled. The rate of feed would be, we are told, 6.4 tons of sand per day, or about 500 pounds per hour. This amount would be delivered over an area of

about 200 square feet, by means of an automatic revolving distributor. We foresee difficulties in the uniform filling of a vat of such a size with so small a flow of pulp. We doubt whether it would be practicable, consistent with normal supervision. In any case, an abundant flow of water would be necessary, and this would lead to other complications. The maintenance of an adequate alkalinity in the mill-water, by the addition of lime, usually favors a satisfactory yield of gold from the plates; but no provision is made for the return of the mill-water, and a serious loss of lime is inevitable; or, as an alternative, there will be a reduced recovery of gold in the mill. The plant is arranged so that all the solution from the vats goes through the zinc-boxes. This is a mistake. Solutions low in gold and weak in cyanide, such as the last washes, should be passed direct to charges of ore in the earlier stages of treatment, the cyanide and alkali contents being adjusted as found necessary.

We question the wisdom of the general recommendations. We consider that work should have been concentrated on amalgamation treatment until a dump had been accumulated, of such a size and gold content as to justify adequate preliminary tests. The results of tests in bottles are often worse than useless; they are misleading. To subject goldbearing tailing and cyanide solution to a violent agitation in a bottle, and then to remove all the solution by repeated washings, is an experimental operation that cannot be duplicated in practice. As a basis for the recommendation of a leaching process, it is an absurd procedure. We consider that the advice of the Bureau of Mines that the operators should erect a cyanide plant of obviously inefficient design for the purpose of treating so small an amount as 6.4 tons per day is fundamentally wrong; we consider it stupid to disregard the cyanide treatment of all the slime, when it contains 40% of the total gold in the tailing; and we consider that flotation is not likely to give either a low residue, a good extraction, or an easily marketable product. The recommendation as to the flotation of the slime from an oxidized gold ore ignores all the work that has been done in small cyanide-leaching plants, where dividends have been paid as a result of the adoption of a method ensuring the thorough mixing of sand with as much slime as possible, and the treatment of the whole in a small, but properly designed and well-equipped unit. With flotation, a residue assay of 0.16 and 0.22 ounce of gold per ton is considered, by the Bureau engineer, as an encouraging result. To us it indicates a serious loss, if not the unsuitability of the process. Further, a product would be obtained, on the sale of which the small operator would stand a chance of being victimized. We regret the issuance of reports such as this by the Bureau of Mines. We agree with our contemporary in New York that the practice encroaches on the domain of professional metallurgists and assayers; we have been guilty of encroaching on this domain ourselves in an endeavor to show that the adoption of the Bureau's recommendations could do the small mine-owner no good. The report in question cost nothing; if the proposals suggested were adopted it is quite possible that it would prove to be worth even less.



Lead Salts in Cyanide Practice

The Editor:

Sir—Referring to your editorial article on 'Lead Salts and Plagiarism' in your issue of February 12, I should like to mention further earlier references to the use of lead salts in cyaniding:

1. Journal Chemical, Metallurgical & Mining Society of South Africa. Vol. III, p. 64 (Oct. 1902).
2. Do. Vol. VI, p. 326 (April 1906).
3. Do. Vol. VIII, p. 266 (March 1908).
4. Do. Vol. IX, p. 10 (July 1908).
5. 'Rand Metallurgical Practice', Chap. IX, p. 387 (1912).

The conclusions quoted by R. W. Perry in the same issue from Fahrenwald's 'Cyanide Process', and those which he has proved by his experimental work, are in the main indicated in the above references.

Johannesburg, April 13.

ANDREW KING.

Prospecting

The Editor:

Sir—Your very interesting address on this subject, delivered before the Portland Mining Convention recently, has aroused in me a desire to make a few comments, and, as I am a real prospector of over 25 years experience in the hills, I have no doubt you will agree that I ought to know a little about the subject.

In the first place, I could not help noticing that you too seem to be under the impression that the genuine prospector is disappearing from the hills, and we read and hear a great deal to the same effect from nearly every quarter, with amusing speculation as to the reasons why, which are quite simple, in my opinion.

I must differ from what appears to be the prevailing impression of what constitutes a genuine prospector, held by those who write on the subject in what they appear to be unable to disguise, a sort of condescending and patronizing tone, as if they were discussing some inferior unintelligent specimen of the *genus homo*, who in his sober moments is more or less of an amiable imbecile, and when not in the hills, is usually found staggering around under a load of Red-Eye whiskey with tobacco-juice dribbling slowly from the point of his chin while he importunes the local saloon-keeper to give him another grubstake, or is showing pocket specimens from his reputed latest find to all who will listen, and begging them to invest \$50 or \$100 or even less, in an interest, so that he can indulge in a little more Red-Eye; Red-Eye, of course, being the only

source of enjoyment for creatures of his calibre, when not wandering through the hills like lost souls. It seems to me that it is a fine thing for humanity if that type of prospector (?) has disappeared from the mountains. Let us hope he has also disappeared from the earth.

Now, my ideal of a "genuine prospector" is quite different, and there are plenty of him left, especially in the newer sections of this continent. He is a man of good strong physique, and just as venturesome and courageous today as prospectors ever were. He is an intelligent well-read man, and frequently well-educated. He does not find whiskey nor any other kind of booze necessary to his happiness, although he can and does take a drink if he feels that he needs it. He scorns to take a grubstake from anyone, figuring that his time and the knowledge he has acquired from books, and that best mining school of all, the School of Experience, are worth much more than the grub he will consume on a prospecting trip. While he hates to work for wages, he does so, when not prospecting or developing claims already located, so that he may be independent and not beholden to any man for the sinews of war. He is able to "size up a prospect", which, as you truly say, cannot be taught in any school of mining engineering.

There are plenty of such prospectors as above described in this section, and, as I have already said, in all the newer parts of the continent, but a great many of them have quit the prospecting game and gone into other lines, where the same qualities that made them good prospectors will be practically sure to make them independent in time, whereas they well know that even the best of prospectors must take his chance of winding up his career in the poorhouse.

The reasons why prospectors are quitting the profession of looking for mines (and it should and I believe yet will be raised to that dignity) are simple, and surely must be quite obvious to many engineers who write to the 'Press' and advocate this, that, and the other remedy for a condition which they have not, or pretend they have not correctly diagnosed.

The reasons most prospectors have quit are exactly the same reasons that cause any other business-man of sound sense to quit any other business in which he may be engaged, namely, inability to make prospecting pay, and the improbability of being able to make it pay during the lifetime of the present generation.

In your issue of January 22, 1921, there appears a letter written by me entitled, 'Ex-soldiers and Prospecting' in which occurs the following paragraph, which I think covers the ground in a very few words. The rea-

sous why prospecting is a poor 'spec' for returned soldiers or anyone else are, "Because there is no demand at present for any of the metals excepting gold, and even that, unless the prospector is lucky enough to find it as a shallow alluvial deposit or as an absolutely free-milling quartz deposit so that he can make it productive by his own efforts, will not do him much good, for the simple reason that otherwise he will be left with a white elephant on his hands, like the thousands of other claim owners, many of whom have good likely-looking propositions near existing lines of transportation, which they are unable to work for themselves from lack of modern machinery or the means to buy it, and therefore must hold indefinitely or sell at their (the companies') figure to the mining companies that have the necessary capital and know it and take advantage accordingly, for every experienced mining man knows that hardly ever does a prospector who is fortunate enough to find a really good prospect, which soon develops into a mine, get enough for it to adequately repay him for the risks he has taken, the time and money he has spent, the disappointments he has endured, and the sacrifices he has made in order to find it."

That the above paragraph is a correct diagnosis of 'What is the matter with prospecting?' I challenge any or all of the engineers who took part in your symposium of 1914 to successfully deny, and, while it may be partly true, as they almost unanimously concluded, "that there was plenty of money for the development of promising prospects", it is absolutely true that the money spent for developing a promising prospect is not going to do the finder thereof much good unless he gets a fair share of its value after development. Rockefeller's income may be one hundred millions a year, but I fail to see that that interesting fact is going to benefit me unless I get some of it.

Those who claim that prospecting languishes because prospectors ask "outrageous prices" for claims are talking pure rubbish, for any claim that is really a prospect worth developing is not bought and sold nowadays for cash, but is generally taken under bond for development, and the prospector gets but little if any cash, until the bonders have satisfied themselves at any rate that the prospect is a mine, and even then, as I have said before, the prospector's share is insignificant and not enough to keep good men in the game any longer than they can help.

If the prospector has certain psychological peculiarities, the mining engineer and investor have also their own funny little ways, as I have observed over and over again. For instance, a mining engineer will come into a new camp and look the prospects over, and select a third- or fourth-class prospect for development, because he can get a bond on it for two years with no cash down to the owner, and the ultimate price only \$20,000. The clever engineer thinks he is doing great business, and then proceeds to spend about \$100,000 or more looking for ore on his bargain (?). At the end of the two years he has a long hole in the ground, but no ore, and perhaps little prospect of finding any. He had previously looked at another prospect of the first class. That is a property on

which the owner had done sufficient intelligent development to show that his deposit had three of the four qualifications necessary in a mine, namely, length, breadth, and payable ore fairly evenly distributed, and it only required development to a comparatively trifling depth to prove it to be a valuable mine. Twenty thousand dollars expended in drift-tunneling on the ore would block out \$2,000,000 worth of ore, provided the deposit maintained its length, width, and value as it went down, but the "outrageous hog" (?) of an owner wanted \$100,000 if the property developed as it did in his own surface workings. Of course, the smart engineer thought such a sum far too much for any prospector, no matter what he had to sell, and turned him down with scorn and took the third-class, but cheap, prospect, which cost him \$120,000 for a worthless hole in the ground. If he had taken the first-class prospect he would have also spent \$120,000, but he would have had a valuable mine to show for it. The moral is obvious.

DONALD C. SIMPSON.

Smithers, B. C., May 10.

The Editor:

Sir—The address on this subject delivered before the International Convention at Portland, and appearing in your issue of April 23, I read with great interest and I must say I found it to be O. K. It covers the subject pretty well. You say you like to hear from the real prospector. Well, if I could write a nice article explaining the matter clearly, I certainly would send one for publication, but unfortunately, as you say, to me the pick is mightier than the pen, and the reason I am moved to write these few lines is to tell you just what I know about prospecting and why the good old prospectors have quit.

Now as to prospecting, such as looking for indications, signs, and anything that might lead to the discovery of ore, I couldn't suggest better methods than Mr. T. A. Rickard did. My idea in writing is to show the principal reason why the old prospector has quit his search on the lonesome mountain, no one taking his place. Present conditions are very unfavorable, not merely because the cream has been skimmed; I myself know that even here in our home State there is plenty of good prospecting ground, not only in the north-eastern part of it, but all the eastern slope of the Sierra Nevada is promising for big mines, but because the prospector can't sell his prospect any more, no matter how reasonable he is; he can't raise money and nobody will back him any more. The prospector's intention is to show up as much ore as he can and then sell out and look for more. Now, unless he hits real high-grade, so that he can ship it at profit, he is up against it. Why? One reason why, Mr. Rickard said, more new mines are not discovered is because the money for development is placed too frequently in the hands of ultra-conservative technical men who hesitate to incur the responsibility for which they have been retained. My experience in this game will prove this to be a straight fact. Now, don't get sore with me, you mining engineers, if I make this remark: that the mining engi-

neer is the worst enemy the prospector has got. The prospector with a prospect for sale hates to see the consulting mining engineer approaching his claim because he knows that if he is sent there by others to investigate or to examine the property, he will condemn it, sure. The engineer will turn it down, even when the property is pretty well developed and warrants a safe investment; he will take no chances; he's afraid to make a mistake and, in short, he is afraid of losing his job. Some people think the M. E. is an adventurous man, I guess just because he's managing and directing the mining industry, but we old prospectors know different. He is taking no more risk than a machine-shop mechanic.

Well, of course, business is business, and—safety first. However, I don't mean to say that the mining engineers are all alike. I think it would be wrong to say that. However, those that I have had anything to do with were just as I put it down here. In 1911 I was operating a lease and bond on a claim in Mono county. I had good ore in different places along the surface, but unfortunately it was quite irregular. There was not enough high-grade to ship, and no mill was available to treat the low-grade. I was at it for seven months. The beans and bacon was getting pretty low. One night I noticed an 'ad' in the 'Mining World'. "Gold prospect wanted. Write full description to Mr. Moneyed Man, Reno, Nevada". So the very same night I got up the description of my workings the best way I knew how, and sent it right off to Mr. Moneyed Man. Two days afterward I got a message from him to hold the ground, and an engineer would be out to see it immediately. After waiting several days and seeing nobody coming, I wrote to him asking what was the matter. He replied, saying he had found out from mining engineers that my ground was no good. Well, what can a man do?

I was positive that a big mine was in that hill, but I was approaching a time when something had to be done; I had to get somebody interested or let the ground go back to the farmers. So I put about 50 pounds of good ore in a sack and out I went to Reno with the intention of doing some business with somebody. Nothing doing. I had the ore about me, so I went up to see the Mr. Moneyed Man. I showed him the ore, but he didn't care to look at it: "My engineer," says he, "will be in shortly, he'll look at it." In a quarter of an hour before his man came in I remember he asked me this question 50 times: "Do you think there is a mine there, Mr. Perini?" "If I didn't think so I would never start to put in my own time on it," I told him. But that is not enough; it doesn't matter what you tell them. However, next day the engineer came out with me. I showed him everything and told him everything I knew about that particular locality. I saw that he was not sampling it right, but I did not say anything. Well, he returned to Reno. Three days after I got a message by wire, thus: "Regret your proposition is not suitable for our purpose." A few days after a man came along and offered me \$500. I took it and gave him an option. His company went right to work on it. They sunk a shaft 120 ft. and started cutting

the formation, and right under my coyote holes there was a nice little vein 14 feet wide assaying right across \$4067 per. This was one of the biggest bonanzas in quartz discovered in the world, but the world hardly ever knew anything about it, as the operators and company caved in that tunnel for four years and denied they had made a strike. I guess it was a freeze-out. Of course, the news spread out so fast that indirectly everybody in the country heard it. So, the first opportunity I got I called on Mr. Moneyed Man. I just wanted to tease him. Well, I said to him, "I guess the proposition would be suitable for your purpose now, wouldn't it, Mr. Miller?" He cursed the mining engineers some, but that didn't do him or me any good. Things of this sort occurred to me more than once, and it seems they happen to others. What we should have to encourage more prospecting is what I would call a prospector's bureau, run by a man who must be well qualified with technical and practical experience, a man like Mr. Rickard undoubtedly would fill the place. This bureau would serve as a place for the prospector to list his prospects with a description of same. The prospector should furnish a report and other data, telling just what he has. The person in charge of the bureau ought to be a good judge, able to tell if the prospector is sincere in his statement or not, able to find out why he wants to sell out, etc. This would give him an idea whether it was worth recommending or not. The bureau ought to be so largely advertised that everybody in the country would know what it was for. Then those desiring to speculate a little on a mining venture would know just where to go to get information. If we had something of this kind, the prospector would have something to fall back on, but the way it is now is disappointing. However, I have got to stay with it. I may get a streak of good luck yet; at any event, soon I'll be out in the mountain taking a chance once more. If I hit it rich I'll let you know.

Santa Barbara, California, April 25. S. L. PERINI.

Origin of Spanish Names

The Editor:

Sir—In your issue of March 12 you explain the origin of some Spanish names in the American South-West. I think you go too far in your guess as to the meaning of 'Arizona'. The discoverers of that dry land, thirsty after their ride, certainly exclaimed many a time that it was "*arida zona*" or 'arid zone', from which Arizona soon became the common name, and that explanation is good enough to any one born to the Spanish language.

These contractions are very common in Spanish. I have been amused at Americans who speak good Spanish being puzzled at the word *pundonor*, which is simply a contraction from *punto de honor* or "point of honor".

I believe California is a name similar to that of Arizona. The discoverers must have found Lower California 'as hot as a furnace', and since 'f' and 'h' were then so interchangeable, somebody invented the expression *caliente forno*, from which California was soon contracted.

You have another case like that in 'Cape Horn': Magellan named the extreme end of South America *Tierra del Fuego*, from the fires that the natives lit near the shore, and, of course, the Cape was named *Cabo de Hornos*, or 'Cape of the Furnaces'. English mariners looking at the early charts very soon aspirated the 'h' and you get 'Cape Horn', but a horn is not a furnace.

The word 'sherry' is the nearest your English forefathers could come to pronounce the old Spanish name Xerez or Jerez, as the wine is now called. They started calling it 'sherez', and soon came the present name 'sherry'.

I am always distracted when I see people writing about the 'Ladrone Islands'. They do not know that *ladron* (thief) takes 'es' to make the plural, since a consonant cannot take a simple 's' for the sake of euphony. A word ending in a vowel adds an 's', like *padre*, *padre-s*, but *mujer* makes *mujer-es* and *ladron*, *ladron-es*.

Mexico City, April 14.

VICTOR M. BRASCHL.

Russian Placer Mining

The Editor:

Sir—Your issue of April 30 contained a letter written by Mr. G. L. Holmes in which he sets forth very plainly the erroneous conclusions of Mr. Leon Perret regarding the advantages of steam-driven gold dredges over those of the electrically driven class. Mr. Holmes' many years of experience in gold dredging enables him to draw correct conclusions. These conclusions will be substantiated by almost anyone who has a thorough knowledge of the subject.

The difficulty with Mr. Perret's conclusions is due to a serious error in his figures as set forth in his first article published in your issue of March 19. In the closing paragraph he states that the power-plant of the Kolehnan mines is using from 26,000 to 40,000 cords of wood per operating season. In these figures Mr. Perret was careless in adding one too many naughts at the end.

The consumption of fuel at the Kolehnan power-plant, according to the official reports of the company, has averaged 3500 cords of wood per season, and not 40,000. The Orsk company's Kolehnan 7-ft. dredge in the season of 1915 operated 218 days and dug 628,762 cubic yards, whereas the average of six dredges having the same size buckets as the Kolehnan dredge and belonging to the Demidoff Estate, according to the figures published in your issue of May 30, 1914, averaged 376,200 yards per dredge for a season of 256 days.

The Demidoff dredges are of the well-known steam-driven type for which Mr. Perret claims great superiority, while the Kolehnan dredge was built by the New York Engineering Co. and at the time represented the best in American mining equipment. This dredge, which operated 38 days less than the Demidoff dredges, handled nearly 75% more gravel; moreover, the Kolehnan dredge during the time produced gold to the value of 656,299 rubles. The working cost, including the winter upkeep,

was 112,487 rubles. This showed a net operating profit of 546,815 rubles, or \$271,907, which was about the original cost of the dredge installed and operating. The above figures are taken from the official report of the company.

In Mr. Perret's first article, in your issue of March 19, he states that the Orsk Goldfields yielded no profit during the first nine years of its operation, regardless of the fact that American mechanical methods were adopted. This is hardly a fair representation of the facts, as the two dredges made very handsome money during these years, but were not able to pay dividends on about \$3,000,000, which was included in their capitalization and which had been previously lost in a lode-mine operation some years before the Orsk dredges were installed. It was no fault of American mechanical methods that these two dredges were unable to earn dividends on capital sunk in another enterprise.

The above facts are well known by most everyone familiar with Russian mining enterprises and when one loads American mechanical methods down with such a burden as set forth above, together with 40,000 cords of wood per year for fuel consumption, it is no wonder he is able to make out a good case against American mining methods.

A. C. LUDLUM.

New York, May 19.

Coloring of Glass

The Editor:

Sir—In 1910, I found in the vicinity of Searles Lake, San Bernardino county, the remnants of a broken glass bottle. The color of the glass was violet. The bottle had been, to all appearance, an ordinary medicine one of colorless glass. As the color interested me I broke off the jagged edges from the neck portion and took it home. Some time after I showed it to a friend, who stated that it was a common property of colorless glass to become tinted violet on long exposure, and that in Boston, Massachusetts, some of the residents were very proud of their old violet-colored windows.

In 1913, in Rhodesia, South Africa, I found on top of a granite boss, the remains of a whisky bottle. I knew it to be a whisky bottle because a bit of the label still remained. The bottle had been colorless, because that brand of whisky was put up in colorless bottles. The broken bits were violet-colored.

Has anyone else noticed this and is it known what takes place in the glass? Both of my finds were in places subject to intense and prolonged sunshine.

London, April 24.

FRANCIS DRAKE.

[We are glad to hear from Mr. Drake, and confirm his observation. Most of our prospecting friends would see pink if they found a bottle of whisky, and if it proved the empty shell of a fervent hope they would see blue, not only the glass, but sagebrush and pine as well.—EDITOR.]



THE CARSON HILL MINE AND MILL AT MELONES

Mining on the Mother Lode of California

By A. E. Rau Roesler

The history of gold mining in the past twenty or thirty years has played a very secondary part in the economic development of the country. The expansion of our foreign trade and the position assumed by the United States as a creditor nation has made it possible for the Treasury to maintain so huge a gold reserve that domestic production of gold has become unimportant. This has reflected to the serious detriment of the areas of production, notably the Mother Lode region of California, which is probably the most important source of gold in the United States.

There are today perhaps a thousand patented mining properties in the area called the Mother Lode, and probably three times that many unpatented claims. The production to date is estimated variously at from a billion and a quarter to a billion and a half dollars. The population has decreased tremendously in the past ten years. There are in excess of one hundred idle plants in the region. With the exception of a few prominent mines, all the former producers are closed.

However, there is a curious connection between general industry and gold mining—an underlying relationship that affects the business of gold mining when economic conditions in the country generally become depressed. This is again making itself felt along the Lode and will probably result in permanent gain to the mining of gold.

In business circles it is axiomatic that industrial depression means loss of exports, bringing a closer balance between export and import; the foreign sources of gold become less available and the country turns to its own resources in gold. A time of deep depression and the closing of factories, with idleness among workers, brings an increasing activity in gold mining. Copper, iron,

and the minor minerals used in manufacture suffer with the general commercial business, but gold reacts in an exactly opposite direction. This, then, is a logical time to bring to the notice of the mining world the importance of the area generally known as the Mother Lode of California. It has been measured, mapped, and described, but there has been no work of a technical nature done on the Lode since the time of Ransome and the folios completed in April 1899. The works available are incomplete, incorrect, and not dependable.

An instance is afforded by the Angels Camp district, lying between the Stanislaus river and San Andreas. Mineralogically, geologically, and petrologically it is a separate province, related only geologically to the southern and northern districts of the Lode. Credited with a production of some sixty to seventy millions of dollars in gold, no attempt has been made to either classify or name the form in which the ores occur. To the north and south the deposits are in the form of lodes, or leads, and veins; but in the Angels Camp district gold occurs in a majority of cases in pyritic deposits in the country-rock adjoining great 'bull' quartz veins, and not in the quartz leads or lodes. The mineralogy of the deposits is different from that of the northern and southern areas; the metallurgy as practised suffers from inherited ailments, from methods imported into the district from other localities along the Lode. Because stamp-mills, re-grinders, plates, and concentrators are good practice in the north or south, on the free-milling quartz veins, the sulphide bodies of the Angels Camp district undergo the same treatment, when probably rough grinding, concentration, and cyanidation would be sufficient to extract all the metal made available through the intricate processes used in the

treatment of gold ores containing free gold, and warranting amalgamation. Of course, there must be a stamp-mill; no property in California is complete without one, when the ore to be treated is a gold ore, even though the gangue in which the metal lies is a soft and fissile schist, which comminutes so rapidly that it often clogs the stamps, and requires enormous amounts of water to carry it through the screens. Of course, even in the present practice, cyanidation is used on the tailing and in the recovery of gold from the concentrate.

Geologically the area consists of a series, not one or two, but a series of parallel deposits, separated by a width of over two miles between the eastern and western ore-zones. At Carson Hill there are five of these zones, close together and separated by narrow widths of wall-rock. At Altaville, and the northern part of Angels Camp, there are four to six zones covering a width of two miles. Lying west of these zones and paralleling them is an entirely distinct belt, of an entirely different mineralogical nature, now coming into prominence through the operations of a few mines, that have found in this particular belt a new field for development.

The ore occurrence, the topography, and the mineralogy of the district, as it really is, does not appear in the Geologic folios, nor is the topography correct, so that in using the sheets it is often confusing to find the streams running uphill.

There are many reasons why there are so few producing mines on the Lode today, the principal one being, of course, the advanced cost of materials. Labor has been scarce, but there has never been a marked increase in the cost of labor. Mining is in its third generation on the Lode, and the miners have been born and raised in the district. Besides this there is always, in times of industrial depression, a marked migration of skilled labor to the mining camps. The pay is comparatively good when living conditions are taken into account. Some of the great mines were operating on very low-grade ore when the War began. These were forced to close. But during the same period the Morgan mine, closed for many years past, was opened and now heads the list of productive properties. The Melones mine, closed because of low-grade ore, has been re-opened by the Morgan management and is operating on higher-grade ore than it has known for years. The deep mines at Jackson, the Argonaut and Kennedy, were closed on account of a fire underground, but are to resume production shortly. Every great mine on the Lode today has had its period of inactivity, due either to legal troubles, or to the fact that it was thought that the mine had been bottomed. With as good ore as has ever been found in the mine at 4900 ft. the Argonaut is a refutation of the theory that the ore, on the Lode, gives out, anywhere from the 1200 to the 1800-ft. level. The same is true of the Plymouth and the Kennedy.

After seven years of experience on the Lode, I have come to the conclusion that the closing of the mines is due, in a certain measure, to a failure in technical methods. Then, too, it may be added that the near field is

not green enough, and the very nearness of the Lode militates against it. Two great schools of mining and geology are maintained within easy seven hours run from the Lode. No geological work of importance, however, has been attempted since Ransome finished the folios. The general run of mining engineer seems to fear for his reputation when it comes to examining a once-closed mine on the Lode, and reports adversely after the most cursory of examinations. And yet the history of the Lode, the proved depth of the ore-shoots, and the



UNDERGROUND IN THE CLIO VINDICATOR MINE

enviable history of the newly opened mines should warrant much exploratory work and the investment of considerable capital. The closed mines, however, should be treated more from the geological standpoint than from that of the mining engineer. They should be treated rather as prospects than as mines.

Perhaps the results of the visits of examining engineers, of nomadic geologists, who can run over and condemn a district extending from Jimtown to Angels Camp in 24 hours, has much to do with the present attitude of operators and miners toward technical help. Hellman's report on the Morgan mine is quoted freely since the mine has resumed operation, as a criterion of the knowledge that the average engineer has of real conditions on the Lode. Two of the most important mines in the region are operated by men without technical training and without a technical staff. Probably the owners and

operators have the same ideas that are prevalent on the Lode, that no lode mine can be operated as it should be unless the superintendent is born and bred on the Lode, nor is it possible for one who has not lived continuously on the Lode from childhood to acquire the knowledge necessary for the operation of a Lode property. It does not matter where one is born, whether on the northern, southern, or central part of the region, and although the ore-occurrence in the various areas made be entirely different, the fact that one is indigenous to the Lode appears to be the only necessary qualification for successful mining in this region.

There is a reason for all this, and it is not hard to seek. The Lode is the most available area of its magnitude and possibilities in the United States, or, for that matter in the world; it has suffered greatly from lack of development capital and the shortsightedness of operators; it has become the stamping-ground of the small promoter. Every prospectus of a Mother Lode mine has appended a terrific list of former producers, each with a guessed production of from a million to ten million dollars or more. Where large capital is wary, small capital anxious to become large capital will 'take a chance'. The result is inevitable failure, unless the promoter is more than usually active and successful, and knows his own limitations as a superintendent or as a manager. The supervision or superintendence is, with few exceptions, very mediocre. Technical help is useful in making reports, but the fact of the matter is that usually these reports are made in such a manner that the facts need not be faced, and the facts are that the Lode is a field requiring large amounts of capital, for the successful mine requires depth for a prolonged life, and there are everywhere zones of from a few hundred to four hundred feet in depth that are practically barren. Given sufficient funds to keep development ahead 500 ft. in depth, few mines need close down. That is history.

This may all seem like very harsh criticism, but it is brought out because there is a remedy. The potential qualifications of the Lode, the nearness to markets, the accessibility of the region, cannot be duplicated in any other gold-mining country. No other area is as little known as the Mother Lode, and none as poorly described. It offers a vast and profitable field for constructive geological and metallurgical work. An effort should be made for a re-survey, both topographical and geological, of the entire region, and with this as a basis the careful study and classification of the various mineralogical provinces would inevitably overcome the prejudices that today hedge the Lode from the necessary assistance that only capital and technical knowledge can supply to place it where it belongs: at the head of the gold-producing areas of the world.

DEPOSITS of high-grade bauxite have been discovered recently by the Gold Coast Geological Survey at and near the summit of Mt. Ejuanema on the Kwahu plateau, Gold Coast Colony, West Africa, according to an Imperial Mineral Resources Bureau bulletin. The summit of the hill is about 2300 ft. above sea-level.

An Old Story

Many momentous changes have taken place in the policy of Rhodesian mining enterprises in the past few years, and, generally speaking, these changes have been for the better. Fewer 'wild-cat' ventures are floated, although it can hardly be said that Charterland is altogether free of this species of the carnivora of mining. Years ago a chairman of a Rhodesian gold-mining company, speaking at an annual meeting in far-away London, made a most optimistic statement concerning the prospects of the particular proposition in which the gentlemen assembled were fortunate enough to be shareholders. He spoke of the millions of pounds contained in the ore-reserves 'in sight'. He drew a dazzling picture of the dividend aspect of the company, and to give his optimism a concrete basis of fact, he exhibited a specimen from the mine; a sepeimen containing considerably more yellow metal than quartz. The shareholders, who were mostly estimable old army gentlemen and well-to-do landowners, gazed upon this jeweler's-shop exhibit with intense satisfaction. "Gentlemen," continued the chairman, with the usual flow of a board-room's unctuous eloquence, "I am sure you will agree with me that it is a matter for congratulation that we have been able to acquire a 20-stamp battery on very reasonable terms. This equipment, gentlemen, has now been erected, and I am hourly expecting a cable from our manager in Africa, stating that crushing operations have commenced." The chairman paused, removed his gold-rimmed pince-nez, placed the specimen, with which he had been toying, on the table, and beamed benevolently upon the shareholders as a messenger-boy handed a cablegram to the secretary. The secretary, in turn, handed the fateful document to the chairman, who thereupon read it aloud to the meeting, in response to the unanimous wish of the shareholders. And this is what the cablegram from the manager stated: "Your instructions *re* crushing noted. Erection mill completed. Cannot commence crushing until you return the mine". And the venerable gentlemen thereupon gazed upon one another in amazement. They were not miners and they did not understand. But a certain old squire, more quick-witted than the rest of them, solved the ironical enigma: "That's all there is of the mine—there on the table!" he ejaculated, and he was quite right too. This little anecdote is recited merely to indicate the sort of thing that has happened in the mining history of Matabeleland and Mashonaland—the tale is not recounted with any intent to convey the impression that such incidents are common nowadays.—From the 'S. A. Mining & Engineering Journal'.

GOLD DREDGING continues to hold an important place in Alaskan placer mining, states a U. S. Geological Survey report. In 1919 there were 28 dredges in operation for the whole part of the season, and they produced gold to the value of about \$1,360,000, compared with \$1,425,000 worth of gold produced by 28 dredges in 1918, eight in the Fairbanks, Iditarod, Birch Creek, and Mount McKinley districts, and 22 on Seward peninsula.

Cyanide Notes

By Algernon Del Mar

Although this paper is more particularly devoted to the apparent regeneration of cyanide during zinc-dust precipitation in a particular mill, the detailed description of the precipitation combination with suggestions for improvements may be of more than passing interest. Before approaching the main argument, I shall quote briefly from several authorities, but I shall not touch upon cyanide regeneration by means of chemicals other than lime as generally used for settling or neutralizing acid radicals, nor shall I discuss cyanide regeneration using aluminum as a precipitant, except to quote a line or two from Clennell.

Looking over the authorities available in a library of major size, I came to the conclusion that the subject of cyanide regeneration has received but slight attention; it has been noted only in a few instances, and no theory has been advanced to account for the apparent gain of cyanide when the metalliferous contents of the solution have been precipitated by zinc. The subject becomes of importance when we consider that in some cyanide plants solutions are allowed to circulate as solvents when they could be more directly precipitated. The question then is this, if there be a regeneration of cyanide due to precipitation by zinc, does that regeneration bear any relation to the amount of metal in solution, or will the total amount of regeneration be increased by passing the solutions more frequently through the precipitation process. The data at my disposal are not sufficient to answer these questions satisfactorily, but they indicate a line of investigation that can be followed with profit and interest.

In Wilson's 'Cyanide Process', quoting from Bosqui, we find the statement that by frequent tests it was found that there was not "the slightest difference in quantity between the cyanide present in an ingoing and an outgoing solution from the same boxes". MacFarren, in his 'Text Book of Cyanide Practice', says, "There is an apparent regeneration of free cyanide taking place in the zinc-boxes, shown by titrating the solution entering and leaving the boxes. This may amount to as much as a quarter to a third of a pound of cyanide per ton of solution. The exact cause is indeterminate". In a description of the Minas del Tajo mill, in Sinaloa, Mexico, we find that during a period of eight months there was an apparent increase in strength of cyanide "in the high-grade solutions from 3.280 to 3.560 lb., or approximately 8%, and of the low-grade solutions from 2.640 to 2.740 lb. per ton of solution, or approximately 3%. Drip-samples, taken at the head and foot of the boxes, have shown a regeneration of cyanide for a period of two years, due to the lime present, forming zinc hydrate and liberating cyanide".*

This shows a greater amount of regeneration in the richer solutions than in the poorer solutions, due no doubt to the breaking up of a greater amount of the double cyanides of the metals precipitated. Clennell, in his 'Cyanide Handbook', says that "regeneration of cyanide at the Nipissing aluminum precipitation plant amounts to from 0.64 to 0.72 lb. cyanide per ton of solution, and in addition to this the loss by direct action of cyanide on the metal, which occurs in the case of zinc, is avoided by the use of aluminum".

The mill at which my observations were made is in Sonora, Mexico. The ore is a brecciated feldspar filled with calcite and the prevailing economic mineral is argentite, finely disseminated, the average tenor being 8 oz. of silver per ton of ore. The crushing is done by stamps, followed by grinding in tube-mills, dewatering in Dorr thickeners, agitation in Paebucas, and washing on Oliver filters. The solutions precipitated are from the Oliver filters and from the decanted Paebucas. The overflow from the Dorr thickeners, which follow the tube-mill classifiers, is pumped to a tank to be used in the stamp-batteries. Solutions are titrated three or four times per shift and the average for the day is entered in the daily and monthly reports. Potassium iodide is used as an indicator for strength in cyanide and this same titrated solution is again titrated for lime with sulphuric-acid solution. The precipitation is effected with zinc-dust in pipes leading to a Merrill filter-press and in the press itself. This is a 36-in. press with 24 leaves in which ordinary building paper and *manta* are used for filtering. Newspaper was tried with some success, but the building-paper is slightly more porous and filters quicker.

The present management claims that chemically no lime is needed to better the extraction, but only sufficient need be used for settling the slime and that the higher the lime content of the solution the greater the consumption of cyanide. A former mill-superintendent contended that "a high protective alkalinity was necessary with this ore in order to keep down the quantity of zinc in solution". He then goes on to say that "owing to precipitation of basic zinc carbonate, the cyanide increases as the zinc decreases". Therefore the high protective alkalinity keeps down the zinc and the cyanide strength augments, a direct contradiction of the present method of cyanidation. This is only a side issue; my main purpose is to show the results of titrating the solutions before and after precipitation. Taking a representative month, there was calculated to have been precipitated 3000 tons of solution that titrated 0.68 lb. cyanide per ton before precipitation and 1.0 lb. after precipitation. This represents a regeneration of 960 lb. of cyanide during the month. The consumption of cyanide

*Trans. A. I. M. E., 1910.

was 1.38 lb. per ton of ore and the regenerated cyanide represented 0.32 lb. per ton of ore treated. In another month, when the consumption of cyanide was 1.42 lb. per ton of ore treated, the cyanide strength had increased from 0.80 to 1.08, a gain of 373 lb. of cyanide, or 0.28 lb. cyanide per ton of ore treated. The average lime content at all times was 0.14 lb. per ton of solution. The accompanying graph, Fig. 1, shows the titrations for 12 representative days, from which we gather that whenever the cyanide strength increased before precipitation there was a corresponding increase after precipitation or the increase may be taken as constant. As the variation in the metallic content of the unprecipitated solution was fairly constant, we have no means of determining whether the regeneration was greater the richer the so-

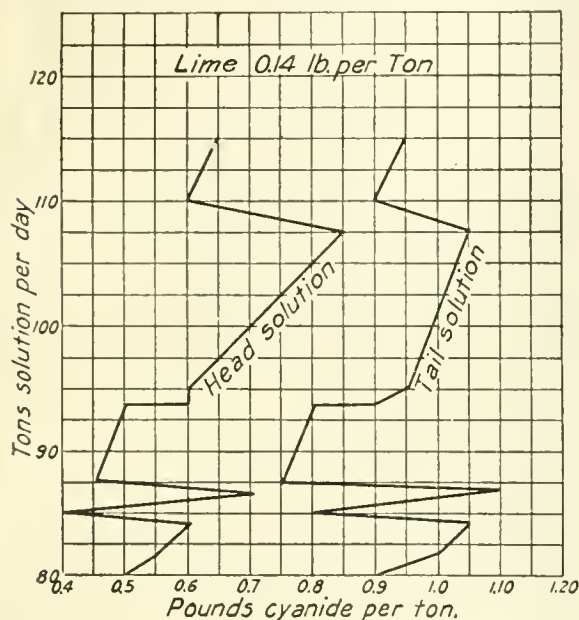


FIG. 1

lution. Owing to causes to be explained later the amount of metal actually precipitated per ton of solution varied considerably, but the regeneration did not follow this condition; it appeared to be independent of the actual amount of precious metal precipitated. This ore contained a small amount of oxidized copper, which may account for the fact that the regeneration of cyanide did not follow the amount of gold and silver precipitated, for the amount of gold and silver did not represent all the precipitation, the bullion containing 8% copper. I have never noted in a zinc-shaving precipitation plant the amount of cyanide regeneration as shown above.

In the month represented by the 1.38 lb. cyanide consumption per ton of ore treated an endeavor was made to precipitate as much as possible of the Dorr-tank overflow, which had always been pumped to the battery-solution vat, but, owing to causes not necessary to state here, this was not done to any great extent, but what little was done in this direction showed a gain, which indicated that a saving in cyanide could be effected by precipitating the solutions from the Dorr tank as well as from the Pachucas and Oliver filters.

A zinc-dust precipitating system should embody certain features to be successful, chief among these being:

1. The zinc-dust must be kept from contact with air.
2. The dust should not be allowed to form lumps.
3. The distance from the zinc intake to the filter-press should be short.
4. The filter-press should always be kept full of solution.
5. An automatic means of feeding the right amount of zinc for complete precipitation, but with no excess of zinc.
6. A means of measuring the amount of solution precipitated.
7. The solutions precipitated should be regularly titrated and assayed.

Fig. 2 illustrates a zinc-dust equipment, not to scale nor drawn with details. Each one of the seven features referred to above will be taken up seriatim in reference to this sketch.

Probably the least amount of air comes in contact with zinc-dust when the original receptacle is used. If this be the usual 100-lb. can, all that is necessary is to unscrew the cap, turn the can upside down on the feeder, and punch a small hole in the top. The zinc will now feed from the bottom and the only air exposure will be a layer on the top of the can.

Various devices have been used for keeping the zinc-dust from forming lumps, but a little ball-mill made from a 6-in. pipe running on roller-bearings answers the requirements. The stream of zinc-dust from the feeder, which may be of the Challenge type, or the screw-conveyor type, is washed into the ball-mill with a stream of water or solution, preferably the latter, as there might be a tendency for the water to oxidize the zinc.

As zinc-dust precipitates the precious metals almost instantaneously, pipes from the zinc-dust intake to the filter-press become encrusted with precipitate and soon little or no solution will flow through them. In some plants the pipes must be cleaned every two weeks, so it is well to provide pipes of large diameter. While the zinc-feeder and the filter should not be at any great distance apart, it is well to have the filter at a lower level, so that the solutions can flow to the press by gravity when the pump is not working. Some operators contend that a long pipe-line is an advantage by giving the zinc-dust longer contact with the solution, and if such should be the case the pipes should be washed on the inside with some paint to which the precipitate will not easily adhere.

When precipitating cyanide solutions with zinc, whether with zinc-shaving or zinc-dust, the zinc must be kept from contact with air, otherwise rapid oxidation takes place and the zinc is rendered unfit for precipitation. If a zinc-dust filter is allowed to become alternately full of solution and then dry, the precipitation will become very uncertain. An instance may be cited where the solution entering the press assayed \$3 per ton, the clarifying-vat had become clogged with slime so that the triplex pump was not only pumping solution into the filter-press, but likewise air. With a great excess of

zinc-dust the discharge solution assayed \$1.80 per ton, showing that when air entered the press, the precipitation was poor. There were two remedies for this condition, the first and best being to keep the standpipe that fed the pump full of solution or to allow the solution to run to the press by gravity without the aid of the pump; the second was to add carbonate of soda to the unprecipitated solution. Clennell says:† "In some cases the addition of sodium carbonate to the solution in the sumps has a beneficial effect, as it precipitates salts which might otherwise cause a deposit of insoluble carbonate in the boxes". I venture the explanation that zinc carbonate is not a deterrent to precipitation, whereas zinc oxide is, and that the sodium carbonate converted the zinc into carbonate in preference to oxide. As the condition causing poor precipitation may happen unawares, it is important to test frequently the precipitated solution, so as to head off poor precipitation as much as possible. This is usually done with sodium sulphide, the depth of

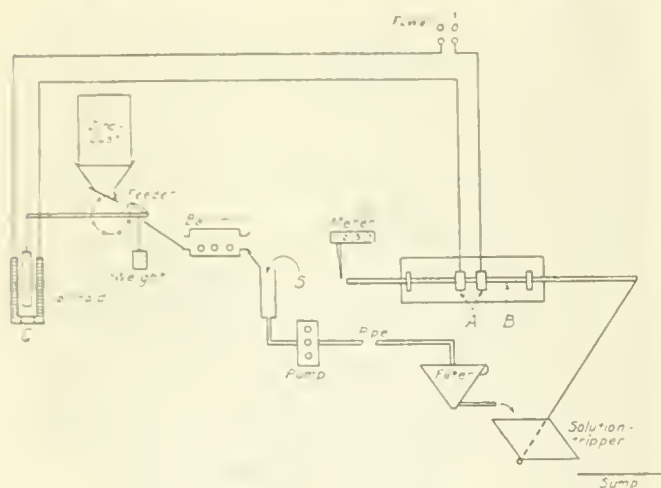


FIG. 2

the color indicating the extent of precipitation and giving a means of knowing when to increase or decrease the amount of zinc-dust. A permanent remedy for oxidation in the filter-press, and one that requires no attention, is to have the discharge from the filter higher than the press itself, so that the filter-press is always full. This has been done in a few mills, and the manufacturers should design the machine accordingly.

Referring to Fig 2, at C, we have a coil in which a magnet is hung. When an electric current passes through the wires at the poles of the coil the magnet is forced down into the coil. By attaching this magnet to a lever we have the means of actuating the feed-wheel of a small Challenge feeder, which feeds the zinc-dust into a standpipe connected with the force-pump. The electric current for this purpose at the Minas Nuevas, in Mexico, is taken from the electric-light circuit. Referring to the letters A and B, when A passes over the two insulated points B, a circuit from here to the coil is completed and the magnet is forced down, to be released when the connection A has broken the circuit,

so that the weight W on the lever pulls the magnet up. Every time the rod on which A is attached passes in the direction of the meter it registers that oscillation. The movement of this rod back and forth is caused by the solution-box tripping when over-balanced with solution from the discharge of the filter-press. Therefore, if we know how much the solution-box or tripper must hold to over-balance, we have a means of registering the amount of solution precipitated. As stated, every time the solution-box over-balances, the electric contact takes place and zinc-dust from the feeder enters the standpipe into which the unprecipitated solution comes, at S. If the metal in solution were constant and all other conditions were constant, once the zinc-dust feeder is set the operation would be automatic. Such conditions are not practicable, so the rate of feed of the zinc-dust must be varied from time to time and this variation is gauged by testing the precipitated solution with sodium sulphide, as is often done for testing zinc-box precipitation.

The solution-box for measuring the amount of solution precipitated when made as indicated in the sketch is not very accurate, because it does not always tip when the solution is at the same level. A better method is to have two receptacles of known capacity, one filling while the other is emptying. When the receptacle is full the discharge is opened and the stream deflected to the other at the same instant. A magnet and an electric connection will effect this operation as in the case of the zinc-feeder.

While it may be facetious to call attention to the fact that solutions should be frequently titrated and assayed, there are many cyanide plants in which one or the other or both of these operations are seldom performed. Particularly, tailing solutions are seldom titrated, but this is important if we would know how to run our plant to the best advantage, for regeneration of cyanide in zinc-boxes or filters is an important factor to be carefully investigated and made the most of. The particular question to be answered is whether this regeneration is dependent or independent of the quantity of metal precipitated and how the conditions favoring the maximum amount of cyanide regeneration can be brought about.

There is food for thought in the following statements quoted:

1. The regeneration is due to the lime present forming zinc hydrate, liberating cyanide.
2. The cyanide regeneration increases as the precipitation of basic zinc carbonate increases.
3. The addition of sodium carbonate in the sumps has a beneficial effect on precipitation.

It would appear that the precipitation of the zinc salts instead of the metal salts is the main cause of regeneration, which would account for the observation that when there was poor precipitation of the precious metallic contents there was the same regeneration.

THE output of asbestos from Rhodesia increased from 9799 tons, valued at £425,240, in 1919, to 18,823 tons, valued at £459,572, in 1920.

†'Cyanide Handbook', p. 294.

Mining Litigation and Common Sense

By Arthur B. Parsons

Judge Elmo E. Bollinger, of the Superior Court of Mohave county, Arizona, in his recent decision in the Tom Reed-United Eastern 'apex' suit, declared in no equivocal terms that, though highly interesting and illuminating, the theories advanced in the testimony of a dozen "eminent geologists and mining engineers" were of negligible value in assisting him to arrive at a conclusion on the issues involved. His Honor certainly ought to know whereof he speaks; the "eminent" gentlemen had devoted several weeks exclusively to the task of enlightening him with regard to the geological history of a small portion of the earth's crust in the vicinity of Kingman, featured by sundry faults, lodes, and ore deposits of great value. Their undivided efforts had been bent solely to his instruction. On the other hand, this same group of men and a number of others, variously classified as geologists, mining geologists, and court geologists, have become recognized generally as an essential cog in the delicate legal machinery that turns out high-grade decisions in disputes hinging on the capricious interpretation of the statutes regarding extralateral rights. When, then, Judge Bollinger frankly declares that they and their technical theories are no more necessary than the proverbial fifth wheel of a coach, such questions as the following immediately assert themselves: Have other judges simply tolerated them, listened politely to their instructive lectures, and then disregarded their scientific theories in favor of practical facts? Is it true that in nearly all litigation involving highly technical problems a large volume of non-essential facts, which dilute and obscure, can be boiled away, leaving as a residuum a simple practical question that the judge settles in his own mind by the aid of common 'horse' sense?

Such are the questions that have provoked the brief investigation that is presented in this article. The statement of definite conclusions has been studiously avoided; the reader may draw his own; then, if they fail to please him, he has no one to blame but himself. The inquiry includes a miscellaneous collection of evidence, some of which may be considered irrelevant and some of which is admittedly hearsay; sundry unanswered questions, of which some are pertinent and others are doubtless impertinent; and a few inferences, some of which may be logical, but none of which are guaranteed to be so. The reader is not only at liberty, but is urged, to season any statement with as much salt as he wishes.

Any individual whose services are in urgent demand at a per-diem remuneration of from \$200 to \$400, together with board and lodging in a salubrious climate like that of Butte, or Salt Lake City, or Kingman, is likely to acquire a measure of self-complacency verging upon

conceit. However, humility is recognized as one of the cardinal virtues, so that such a person should welcome for the good of his soul an occasional frank and detached estimate of the value of his wisdom from a friendly but unterrified critic like Judge Bollinger. The witnesses for the United Eastern side of the suit may seek to derive some small crumbs of comfort from the fact that the recent decision favored the company on whose payroll they happened to be, but they had better not flatter themselves that the Court placed any greater value on their profound geologic doctrines than it did on those of the geologists who advocated the cause of the Tom Reed company. The victors lay in the lap of Fortune. The Judge, after gracious acknowledgment of the "national and international reputations" of some of the "experts", observes that "a few practical miners also testified and furnished the Court with very valuable information because the problems involved in this case are largely practical ones"; apparently it would be presumptuous for United Eastern experts to insinuate themselves into the category of "practical miners" simply to share the glory of victory; they were lucky to be on the side of the practical miners whose views prevailed. By the same token the other well-known geologists who have participated in one or more of the many apex suits tried in recent years cannot hope to escape inclusion in the general indictment—if there be any—simply because they happened not to be engaged in the Tom Reed-United Eastern litigation. All stand or fall together.

The fact should be emphasized that it is entirely consistent to recognize and to appreciate the ability of these men and the value of their geologic learning as assisting in the solution of problems that confront the mine manager and in the advancement of the science of economic geology in our universities, and at the same time to question the value of their services, under the prevailing procedure in mining litigation, to the judge on whom rests the responsibility of deciding a law-suit. If, like the laws of Nature, the statutes made by man were perfect, if they could be depended upon to work with mathematical certainty, there would be neither law-suits nor lawyers. Every individual, by thoughtful study, could ascertain the outcome of litigation beforehand; the man on the losing side would settle out of court. Some are so unfeeling as to assert that lawyers frame the codes ambiguously and unintelligibly for the purpose, primarily, of promoting their own business. The fact that 80% of the seats in Congress and in most of our legislatures are filled by attorneys, coupled with the fact that the members of the multitudinous legal profession live in outrageous affluence, seems to lend a color of truth to the charge.

Whoever their authors and whatever the motives that brought them into being, the statutes exist; their effectiveness depends mainly on the good or bad administration of the courts. The law that accords extra-lateral rights to the holder of the apex of a vein or lode is one of the most practical and simple in its intent, but one of the most intricate in its application. In effect it says to the prospector and miner, "My purpose is to stimulate the search for ore; since you cannot see into the earth to learn which way the lode dips, I shall guarantee to you the right to mine the ore in the lode whose outcrop you possess, even though in following it you go beneath the surface of another man's claim". The principle is delightfully simple; on the other hand, the operation of Nature's laws has given the earth a crust that is decidedly complex. Disputes arose as to the meaning of 'lode', which is not specifically defined in the statutes; and of 'apex', which began to mean more than 'outcrop'. The courts were called upon to interpret the law and to decide the controversies; many decisions were handed down, and the list of precedents became lengthy. The quantity of ore found in a comparatively small vein, and the consequently large amount of money frequently involved, gave the legal battles a gradually increasing importance, and justified the expenditure of huge sums in preparing for, and in conducting, the trials.

Usually the judge knew little of mining and less of geology, so that specialists were employed by the contending parties to give 'expert' testimony, including opinions as well as actual evidence, to 'assist' the judge in his 'findings of fact', which, according to legal parlance, is then complemented by 'conclusions of law'. This 'assistance' necessarily was of two kinds, each having a radically different complexion. One assisted the Court to reach a decision in favor of the plaintiff; the other assisted him to decide for the defendant. Nevertheless the importance of expert testimony increased constantly, and it is an open question today whether the average expectant litigant would choose second-flight lawyers or second-flight geologists if he were obliged to forego the top-notchers in one profession or the other. Of course, this manifest esteem in which expert geological testimony is held by the mining companies does not prove that it is merited; the mining companies may be the victims of a prevailing error.

An insight into the usual methods of conducting a trial involving the law of apex may be gained from the following observations made by a well-known corporation attorney, who has won more important mining suits than he has lost. Nothing would be gained by giving his name, although the statements attributed to him were not made in confidence. His first point was the satisfaction he found in trying such cases before a judge instead of a jury; the training and temperament of the former tend to make him amenable to reason and logic. There is a trace of inconsistency, possibly, in the outline of the strategy the lawyer employs in launching his campaign against the citadel of the Court's judgment in the battle to gain the verdict. The case is studied

from every angle; a major phase of the dispute and perhaps a few minor ones are selected as being particularly strong points in favor of his contention and as being at the same time points most likely to impress the judge. Effort is then concentrated on these aspects of the suit. The maps and other exhibits are prepared so as to lay stress on particular points; much depends on the strategy exercised in coloring the maps. The emphasis gained by repetition is recognized. A hundred maps showing the same geologic fact with slight variations as it appears in each of 100 sections, parallel to one another and a few feet apart, will produce almost a hundred times greater impression on a judge, in spite of himself, than will a single map that adequately shows the essential conditions—or at least so the lawyers think, and they ought to know. Something of the same psychologic inference accounts for the engagement of half a dozen geologists instead of one, although here the aggregate weight of individual reputation is the most important consideration. Guided by the astute attorney as ring-master, these witnesses are put through their paces. They go by devious routes but they always manage to conclude by giving emphatic endorsement to the one fact that has been selected as the focus of effort; indeed, clever lawyers will manage to make each witness say the same thing in half a dozen ways, the better to accentuate the idea and to drive it home to the receptive auditor on the bench. It should be made clear that these are the self-confessed tactics of one good lawyer; there is no direct evidence at hand to implicate others.

But this is the offensive side of hostilities only. Every good general must have a defense. The opposing side has just as many exhibits and just as many witnesses, with college degrees and professional careers no less illustrious. Strangely enough, the things that the first side has indicated on its maps in a glaring shade of red that will not be denied, have been tinted a delicate blue or a dingy gray by the artists of the opposition. It would appear that they deem the outstanding features of geology depicted on the first set of exhibits as being of but little real importance, whereas on the other hand they have applied color lavishly to certain other geologic formations.

If it were not for the fact that there was virtual concurrence between the Tom Reed and the United Eastern advocates as to the structural and other geologic conditions in the ground in controversy, it might be suspected that Judge Bollinger had in mind two sets of exhibits when he remarked in his decision: "The Court realizes, by reason of former practice as a lawyer, that it is hard for counsel for respective parties to an action to see the law and the evidence in a given case, except through the glasses of the particular and favored color of his client, and, as partisans, lawyers are prone to pick out the different properly colored streaks of the law and the evidence; and, putting them together, urge that that particular combination is the real rainbow. . ."

But the most effective defensive maneuver is to confuse and befog the issue in those particulars wherein

advantage lies with the enemy. Testimony is given deliberately for no other reason than to bewilder the judge; the object is to stimulate doubt and uncertainty in his mind with respect to the dangerous contentions of one's opponents. This appears to be an imposition on the judge, but he is used to it; and "all's fair" in litigation.

'Court' geologists have been criticized because of the wide divergence of views expressed in the testimony of two opposing groups of witnesses. The question has been asked how six honorable engineers can testify as to a set of facts, only to be followed by six equally honorable and equally intelligent men whose views regarding the same facts seriously conflict with, if they do not flatly contradict, the sworn testimony of the others. With respect to contradiction of fact, this is invariably found in minor details; as to questions of interpretation, there may be honest difference of opinion. Generally, however, the apparent contrariety is a matter of degree, magnitude, or distinctness. The great truth that one of the litigants wishes to impress on the Court stands out on the mental horizon of his witnesses like the Woolworth building on New York's sky-line; it is a prominent, shining, clear-cut fact. The witness does not deny the existence of the vital facts championed by his opponents, but unconsciously he has so schooled himself that to his eyes they appear dwarfed and dingy, like a four-story loft-building on lower Broadway; he hedges them around with provisos and conditions, with limitations, evasions, and dubious admissions, hoping the Court will be unable to distinguish the unimpressive structure. His object is to leave with the judge a reproduction of his own mental picture that he has skilfully 'touched up' to emphasize certain features and to submerge others in a mass of non-essential and obscuring details.

It is a shrewd judge whose discernment is sharp enough to pierce the smoke-screen of technical geology, to sort out and discard the irrelevant from volumes of evidence, and to reserve the essential facts on which to base his decision. It is a wise judge who can sift the fact from the fancy, who is able to draw a sketch on the back of an envelope that depicts the real point at issue just as clearly as a few hundred handsome and expensive maps. Still, there is convincing evidence that some of our judges have done that very thing. A few examples may be cited.

The case of *Elm Orlu v. Butte & Superior* will be recalled. In the first suit the Elm Orlu, controlled by Senator W. A. Clark, had obtained, through a favorable decision by Judge Bourquin, possession of sundry ore-bodies underlying the Butte & Superior company's Black Rock claim by virtue of an established apex on Elm Orlu ground. It was contended that the Pyle and other so-called branch veins, which at this point on their strike were barren stringers and had never been mined, apexed in Elm Orlu ground; and that they carried with them ownership of ore in the combined vein below the point where they made junction with the Rainbow lode just above the Black Rock 1100-ft. level. The dip below the line of junction coincided more nearly with that of

the stringers than with that of the Rainbow above the junction. In preparation for the trying of the supplemental suit, ten raises from 500 to 1200 ft. long were driven and six miles of special drifts were run. The chief counsel for the plaintiff stated in court that \$500,000 had been spent by his side alone in doing this work. The models and maps were the most elaborate and costly ever prepared. The diagnosis of the unusually complex intersections and faults taxed the ability of the ablest geologists, and the trial was characterized by long and highly technical examinations and grilling cross-examinations.

After three weeks in court, during which 11 witnesses had been examined, it was announced suddenly that a settlement by stipulation had been made by the opposing counsel. By the terms of the stipulation the Butte & Superior relinquished 186 ft. of the Rainbow lode, from which the greater part of the ore above the 1900-ft. level had already been extracted, and paid \$2,500,000 in cash, although the actual profit netted by the Butte & Superior company by milling the ore taken from the disputed block had been estimated at from seven to eight million dollars.

However, the significant point is that on the day before the unexpected dénouement, Judge Bourquin had propounded to one of the witnesses a query to this effect: "If you had discovered this branch vein [referring to one of the Pyle veins] on the surface, would you have followed it for a thousand feet into the ground in the hope of getting ore?" This was an extremely practical question. It suggested the trend of the judge's thought. How much influence it had toward precipitating the settlement can only be surmised, but it is hard to believe that the sequence of events was purely accidental. Did one of the attorneys for Senator Clark suspect the incubation of an idea that he was afraid to let develop? Did someone interpret that plain question as indicating a tendency on the part of the judge to subordinate the intricate problems of vein-structure and relativity to the more practical one of what a miner would have done under the circumstances?

Apropos of this suit an interesting discussion took place as to whether it would be possible for any one of the expert witnesses to give just as effective testimony on the other side, providing that, at the beginning of his study of the problems involved, he had been searching for evidence to support the contrary view. One man pointed out that a witness usually knows little of the detailed geology of the mines when he is retained; and that, although provision is always made for withdrawal from the case in the event that the expert cannot conscientiously support the position taken, no such withdrawals are on record. The psychologist would point out that environment, the contact with other engineers, whose point of view naturally accorded with that of their clients, would necessarily have a strong influence in molding the theories of each individual. Another engineer suggested an experiment: even though the performance is impossible, the suggestion offers food for entertaining

speculation. He proposed that the minds of the ten experts be wiped clean of all facts relating to the history of the litigation and to the geology of the Black Rock and Elm Orlu mines, as a boy might sponge his slate. Each man would then make an entirely independent study of the geology of the two mines, the claim-maps, and the patents; then after as much deliberation as he wished, he would select the side for which he would prefer to be a witness. How closely would the new alignment resemble the old? Might all ten select the same side? Might the cleavage in the ranks of the contingent from Minneapolis disappear; might the Mills building and the Crocker building in San Francisco find themselves allied; or might it turn out that the shades of geologic theory propounded at Massachusetts 'Tech' would not square with those approved at the University of Wisconsin?

In the more recent suit involving mines at Bingham, Judge T. D. Johnson decreed that a thick limestone bed containing rich orebodies nearly 2000 ft. from each other, and separated by a quarter of a mile of practically unaltered limestone, could not be construed as being a lode entailing extra-lateral rights under the apex law. Accordingly, he found against the Utah Consolidated and in favor of the Utah Apex company. After reviewing in admirable fashion the testimony of the expert witnesses, and reciting his views of sundry decisions cited by the opposing counsel as valid precedent, the Judge, in the paragraphs immediately preceding his conclusions, says:

"The witnesses for the defendant testified that this intervening limestone was ground in which the miner might reasonably expect to find ore by driving or cross-cutting in any direction. As stated by counsel of the defendant in their brief, for more than 20 years this property has been operated by the defendant and its predecessors, during which time there has been taken from the mine ore to the value of 40 million dollars. Notwithstanding such immense resources the defendant has failed, except to the limited extent heretofore indicated, to prospect this limestone or develop it. I cannot escape the conviction that if there was reasonable expectation of finding ore by driving or cross-cutting in any direction in this limestone, the defendant, as a practical miner [note the word 'practical'] at the time it ran tunnels and drifts through this intervening limestone, or since, would have cross-cut the limestone, and that it would have extended some of the many short drifts and cross-cuts now terminating along the upper and lower edges of this undeveloped country."

Was not this the real crux of the problem? It requires little stretch of the imagination to believe that the Judge, with keen insight, perceived this simple fact to be the key to the adjudication of the controversy; having decided upon the verdict, he commenced the task of preparing his written opinion. He had at hand the two carefully prepared briefs, submitted by the opposing attorneys, each of which offered a plausible, adequate, and tenable interpretation of the law in light of the facts. The Judge merely selected the one that was in accord with the

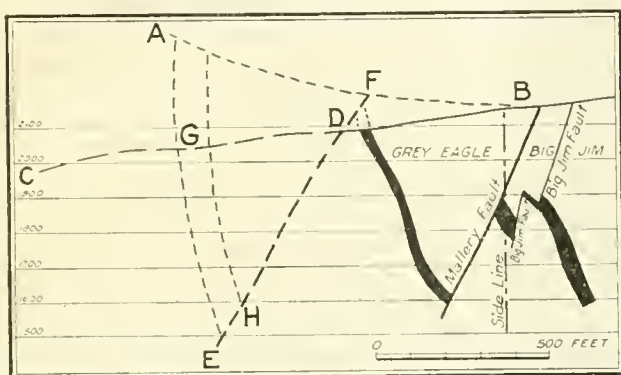
conviction he had reached already and wrote his decision accordingly. The fact that this decision is considered to be something of a classic among similar documents, and that geologic problems are discussed in precise technical terms, does not indicate necessarily that the verdict is not based entirely on a simple question of practical common sense.

But to revert to the recent suit at Kingman. Judge Bollinger, in contrast to Judge Johnson, displays a woeful lack of discernment in his use of geologic terms; indeed he occasionally takes such unjustifiable liberties with geologic fact as may well shock the sensibilities of a proper scientist. However, this is in connection with inconsequential points. So far as the essential facts are concerned, his perception seems to be keen and his exposition clear. For instance, in his dissertation on apices in general, the verbiage may be described as amateurish, but the Judge knows what an apex is, notwithstanding. He does not presume to question the ability of the geologists nor the accuracy of their observations; he is convinced that their conclusions are sound. The issue has to do with the ownership, by virtue of extra-lateral right, of ore in the faulted portion of a vein that has its apex in the Grey Eagle claim owned by the Tom Reed company. This vein has been cut by two faults into three segments; the movement has thrown the lower segment upward, the main dislocation along the Mallery fault amounting to some 400 ft. The conditions are indicated in the accompanying sketch; the Big Jim claim is owned by the United Eastern company.

The Judge is satisfied with the evidence that establishes the identity of the faulted portions of the vein as having *once* been the lower extension of the main vein. He recognizes a horizontal displacement along the Mallery fault of several thousand feet and calls attention to the fact that therefore the ore deposit in the faulted segment could never have been physically attached to the particular orebodies being mined in the Grey Eagle claim. While this is a novel point, he says definitely, that the defendant would be entitled to judgment even if there had been no horizontal movement.

The Judge frankly ignored geologic history and based his decision on "conditions as the miners find them in the ground today". There was no conflict between the statements of the geologists who testified for both sides in so far as matters of physical fact were concerned. They did differ as to the interpretation of the term 'apex' within the meaning of the statute; but it is the province of the judge himself to construe the meaning of the law. The lack of geological issue is presumptive evidence that there necessarily must have been a 'practical' issue, or no basis for a suit would have existed. The Court puts its finger on this practical issue when it says, to quote from the record: "In other words, if this case should be decided upon the theory of origin, the plaintiff would not own the Tom Reed vein as found within the Bald Eagle and Grey Eagle claims, but that property might be successfully claimed by some owner of barren ground a few thousand feet away".

That this statement, particularly if the word "barren" be deleted, is entirely reasonable can be seen clearly by reference to the accompanying sketch, in which the full lines represent conditions as shown on the exhibits before the Court and the dotted lines represent one of a dozen imaginary but entirely plausible hypotheses. The line *AB* represents the surface in an earlier geologic period; *CD* is a continuation of the present surface; *EF* is a fault similar to the Mallery fault. *GH* is a lode outcropping at *G* in a claim owned by a third party. Geologists could readily prove the identity of the main vein in the Grey Eagle claim as being the 'downward' extension of the lode *GH*; incidentally a possible horizontal dislocation along the fault-plane *EF* conceivably might have thrown the ore deposits miles apart without preventing the establishment of a valid geologic connection. But aside from this, it is clear that both the Tom Reed and United Eastern companies should be held



to account for the appropriation of ore that did not belong to them—if the law were carried out in exact accord with the geologic theory of the structural relations of ore deposits. Perhaps Judge Bollinger actually visualized some such set of conditions; perhaps intuition told him of the complications that might arise; at any rate, we have his word for it that common sense and practical considerations decided the issue, whereas several thousand pages of expert testimony had served little purpose but to encumber the archives of the Mohave county courthouse.

The suggestion has been made that a practical arrangement might be effected whereby the judge would appoint one competent geologist of commanding professional standing to make an impartial report on the area involved in litigation. He would be authorized to have performed the mine-work necessary to establish important facts, and to engage technical assistance if necessary; his sole object would be to obtain and report such information as would clarify the issue for the benefit of the Court. He would prepare a few plain, accurate, and informative maps to replace two huge arrays of artistic but distorted affairs usually offered as exhibits. As an unbiased representative of the court, he would advise the judge regarding the essential features of geologic history, dealing with the genesis of the ore and the probable movement of the enclosing rocks before and after its deposition. It is contended that a man delegated to perform such a task would take exceptional professional

pride in his work and that he would come as near the truth as is humanly possible. It may be objected that too much would depend upon the knowledge, judgment, and integrity of one man; as an alternative a commission of three might be appointed to collaborate. Almost any one of the group of scientists who have participated in recent trials would be competent in every way either to serve alone or to co-operate with others as an unprejudiced advisor to the court. Of course, partisan testimony of the kind that Judge Bollinger characterizes as 'practical' would be admitted and the lawyers would not relinquish their cherished prerogative of presenting their oral arguments and their printed briefs.

Some such procedure would have obvious advantages. It certainly would be far more satisfactory, from every point of view, for the judge; likewise for the geologists, unless perchance some of them have become so accustomed to the stimulating mental diet afforded under the present system that geology unseasoned with the spice of contention would be unattractive. Some method like that proposed, obviously, would be more economical; the cost of preparing for, and trying, the case would be reduced many-fold. One all-important consideration remains: the purpose of court proceedings is to determine the issue as nearly as may be in accord with the facts and the law. If this purpose is best furthered and if the rights of the litigants are best protected by the present prevailing custom, the keystone of which is partisan 'expert' testimony, with all its inherent wastefulness, there is no more to be said.

It is probable that Judge Bollinger absorbed more light from the testimony of the geologists than he realizes; nevertheless their testimony was not vital to the outcome of the suit at Kingman; there is sound basis for the belief that Judge Bourquin sensed the solution of his knotty problems as being elsewhere than in the intricate meshes of geologic theory; and strong evidence points to the conclusion that purely practical considerations convinced Judge Johnson of the direction in which justice lay in the Bingham controversy. All of which may, or may not, be accepted as reason for concluding that the ends of justice may be served quite as well with a much more sensible procedure for bringing geologic evidence before the Court.

Has the litigation of apex disputes become a travesty on justice; is one of these suits a huge burlesque, or would it be one if it were not for the great sum of money involved and the large amount of conscientious study and serious effort that it represents; have the geologists who serve as expert witnesses, the most ridiculous parts in the performance, namely, that of 'heavy' comedians, to be alternately coaxed and pampered, derided and browbeaten by opposing counsel? If these things are so, are they caused in part at least by a juridical procedure that is radically wrong, more particularly with respect to the placing of self-respecting geologists in the equivocal position of acting at one time both as truth-seeking scientists and intensely enthusiastic partisan advocates? Is there need for reform based on common sense?

Company Reports

HEDLEY GOLD MINING COMPANY, LIMITED.

Report for the year ended December 31, 1920.

Property: Mine and mill in British Columbia.

Operating Official: G. P. Jones, general superintendent.

Financial: Loss on year's operations, \$1940.59.

Development: 690 ft., with 2210 ft. of diamond-drilling.

Production: 38,053 tons of ore was milled of an average assay value of \$8.72; recovery was \$234,985.55, or 87%.

General: The mill operated from March till September only; development work was carried on during the remainder of the year.

TONOPAH EXTENSION MINING COMPANY

Report for the year ended December 31, 1920.

Property: Mine and mill in Nevada.

Operating Official: J. G. Kirchen, general manager.

Financial: Net income, \$261,615.79; available surplus, \$63,982.51; dividends, \$258,542.48; dividends to date, \$2,684,526.55.

Development: 9114 feet.

Production: 89,022 tons milled, of an average grade of \$15.591 per ton; tailing loss, \$1.232 per ton; receipts from sale of gold and silver, \$1,283,520.72.

Remarks: Sodium cyanide (100%) consumption per ounce of bullion was 0.1555 lb.; zinc consumption per ounce of bullion was 0.0597 pound.

CENTRAL EUREKA MINING COMPANY

Report for the fiscal year ended April 28, 1921.

Property: Mine and mill in California.

Operating Officials: A. S. Howe, superintendent; H. Warrington, assistant superintendent; W. J. Bryant, mine foreman; G. P. Harper, mill foreman.

Financial: Bullion and concentrates account, \$424,068.08; balance in treasury, \$15,962.58; dividends, \$94,227.84.

Production: Tons mined, 37,856; milled, 37,986; extraction, \$11.001 per ton milled; tailing, \$0.898 per ton.

Development: 2073 feet.

KENNECOTT COPPER CORPORATION

Report for the year ended December 31, 1920.

Property: Mines and mills near Kennecott, Alaska.

Financial: Operating revenue, \$8,437,190.62; operating cost, \$5,185,700.01; total income for the year, \$6,477,020.82; balance to undivided profits, \$5,197,334.44; dividends, excluding capital distributions amounting to \$2,787,081, \$2,787,081.

Development: Kennecott, 13,630 ft., with 14,936 ft. of diamond-drilling; Latouche, 8652 ft., with 4846 ft. of diamond-drilling.

Production: 674,472 tons, containing 4.175% copper, mined; 91,991 tons to smelter, of average copper content of 28.50%; receipts at smelter, 51,365,261 lb. copper and 507,726.88 oz. silver.

DALY WEST MINING COMPANY

Report for the year ended December 31, 1920.

Property: Mines in Utah.

Operating Officials: O. N. Friendly, general superintendent; G. R. McKay, mine superintendent.

Financial: Receipts, \$622,274.22; expenditures, \$343,744.94; net gain, \$278,529.28; dividends, \$225,000; dividends to date, \$6,831,000.

Development: From Judge M. & S. Co. levels, 2810.5 ft.; from Daly West levels, 3530 ft.; by fissure systems, Daly vein, 1188.5 ft., middle vein, 220 ft., back vein, 2121.5 ft.

Production: Mine, 22,002 tons; shipped, 10,825 tons; metal contents of ore sold, 505,506 oz. silver, 240 oz. gold, 3,364,606 lb. lead, and 341,465 lb. copper, which sold for \$615,464.45.

JUDGE MINING & SMELTING COMPANY

Report for the year ended December 31, 1920.

Property: Mine, mill, and electrolytic zinc plant in Utah.

Operating Official: O. N. Friendly, general superintendent.

Financial: Receipts, \$1,133,309.87; expenditures, \$892,003.36; dividends, \$180,000; balance, \$61,306.51.

Development: 2793 feet.

Production: Mine, 41,316 tons; shipping, 9150 tons containing 483,890 oz. silver, 649 oz. gold, 7,877,121 lb. lead, and 359,186 lb. copper. The electrolytic plant produced 2,808,000 lb. of premium-grade zinc.

General: The zinc concentrate produced is being stored until such time as the metal market and the final decision of the Commission make a resumption of operations possible.

UNITED EASTERN MINING COMPANY

Report for the year ended December 31, 1920.

Property: Mine and mill in Arizona.

Operating Officials: R. W. Moore, general superintendent; J. W. Carroll, mine foreman; B. C. Stalger, mining engineer; E. M. Bagley, mill superintendent.

Financial: Receipts, \$2,192,633.77; expenditures, \$1,800,015.19; dividends, \$981,360.

Development: Assured reserves, 222,086 tons of an average value of \$18.46 per ton.

Production: 102,326 tons for a yield of 101,161.242 oz. gold, and 75,737.872 oz. silver.

General: The mill superintendent reports satisfactory operation of the mill, with a recovery, based on metals actually produced, of 97.05%. Skimmings recovered during 1920 were included; without this the recovery would have been 96.80%. Aero brand cyanide was experimented with; the results were encouraging; a saving of about 3 cents per ton milled was effected by substituting this for the sodium cyanide previously used. Steel slugs are being used in the re-grinding mills; these are made from discarded drill steel. A saving of about 4 cents per ton has been effected by this innovation.

PHELPS DODGE CORPORATION

Annual report for the year ended December 31, 1920.

Property: Mines, mills, and smelters in Arizona, New Mexico, and Sonora, Mexico.

Operating Officials: P. G. Beckett, general manager; Copper Queen branch, G. W. Dowell, manager; Morenci branch, J. P. Hodgson, manager; Burro Mountain branch, E. M. Sawyer, manager; Stag Canyon branch, W. D. Brennan, manager; Moctezuma Copper Co., H. T. Hamilton, manager; Bunker Hill Mines Co., J. H. Davis, superintendent; Phelps Dodge Mercantile Co., W. A. Meyer, general manager.

Financial: Income, \$35,930,177.72; expenses, \$35,197,066.21; net income, carried to balance sheet, \$733,111.51.

Dividends: Regular dividends to the amount of 10% were declared during the year.

Production: Ore extracted, 1,565,547 tons, including 89,038 from lessees, and 261,277 mined by steam-shovel; 233,914 tons went to the leaching plant at Bisbee, 734,446 tons was concentrated, and 597,187 tons was direct-smelting ore. Copper-bearing material smelted at the Copper Queen works was 787,985 tons. Copper bullion produced contained 17,269 oz. gold, and 1,643,115 oz. silver.

Development: 226,659 feet.

General: Freight-rates and taxes in the State of Arizona have reached a point where they are seriously menacing the output of any but high-grade ore. Western taxes alone having trebled since 1914.

REVIEW OF MINING

PROPOSED REVISION OF MINING LAW

H. Foster Bain, Director of the Bureau of Mines, has made public the report of the Committee on Revision of the Mining Law, appointed by the Director of the Bureau on January 23, 1917, following the recommendation of the Council of the Mining and Metallurgical Society of America. The members of the Committee are: W. R. Ingalls, Walter Douglas, J. Parke Channing, J. R. Finlay, John Hays Hammond, Hennen Jennings, and L. D. Ricketts. Horace V. Winchell was appointed to take the place of Mr. Jennings at the time of his death. The report was made after exhaustive discussion, and after taking a referendum vote upon a

carded actual discovery of a mineral deposit as a prerequisite to the location of a claim, but we provide that such discovery must be made before the claim may be patented and complete title to it be thereby secured. We allow a liberal, but not unreasonable, time between location and the necessity for applying for patent. We provide for the location of large areas. We require the lines of mineral claims to conform to the subdivisions of the general land survey, there being good reasons why they should and no good reasons why they should not. We modify the present requirements of assessment work for the holding of claims. All of these changes are made with the contemplation that



Chart Showing Fluctuations in the Price of Metals. Reproduced from 'Steel and Metal Digest'

questionnaire submitted to sundry professional and technical organizations throughout the country.

The opinion expressed by these questions was practically unanimous on three points, namely, that the extra-lateral features of the existing law should be abolished; that the requirement of discovery as a prerequisite to the location should be abolished; and that otherwise the provision of the existing law should be preserved both as to terms and as to language as far as possible.

The report of the committee is a careful, deliberately considered opinion to be used as a basis for the drafting of a bill to revise, amend, and codify the laws relating to the location of mining claims. In his report to the Director of the Bureau, W. R. Ingalls, chairman of the Committee on Revision, says:

"We have abolished the extra-lateral features of the existing law and have confined proprietary rights in the minerals to what are comprised within the vertical projections downward of the surface lines of a claim. We have dis-

carded the development of new mines in the future will be to a large extent in a different way from what has prevailed in the past.

"In pursuance of the same thought we have introduced an entirely new provision, namely, to afford means to operators of mines to acquire large areas of land for storage purposes. The conditions of modern mining lead to the transfer of material from its original place to another place to the amount of many millions of tons. Such material, especially when it be mill tailing, contains quantities of metal unextractable under present conditions, but possibly capable of extraction at later dates by virtue of improvements in the arts. In the past untold millions of dollars have been wasted by the dispersal of such material by pouring it into streams. This committee is unanimous in the opinion that in the interest of the conservation of natural resources no mine operator should be permitted to waste such material, but should be required to preserve it in the interest of future generations. It follows naturally from the idea of such preservation that

ground must be afforded for the purpose, and the committee proposes therefore to give to mine operators the right to acquire unlimited areas of the public land for such purposes. It guards against the abuse of such a right by the requirement that such land must be paid for at rates per acre very much higher than obtain with respect to any other public land, that such payments buy only the surface rights, that the acquisition of such areas under such terms confer nothing of the underlying mineral rights, and finally that each application shall be approved by the Secretary of the Interior.

The bill that we have drafted covers the location of mineral deposits of all forms, whether in lodes, disseminations, or in alluvial placers, except that it does not cover the location of coal mines, petroleum lands, and the several forms of mineral deposits that now come under the leasing acts. Apart from the changes that have been indicated in this report, the accompanying bill follows very closely the lines of the existing mining laws, and preserves their language to the maximum extent possible. The existing laws which are now scattered through the statutes have been assembled and codified in one law. There is nothing in the accompanying bill that changes any rights to mineral deposits that have been acquired under existing or previous laws."

NEW POWER-PLANTS FOR UTAH MINES ARE PROJECTED

At a meeting of representatives of the principal coal mining companies in the State on June 1, tentative plans for the erection of a large steam-power plant in Carbon county were discussed. F. A. Sweet, of the Standard Coal Co., stated that the coal-mining companies believed such a plan feasible, and that it would reduce their present power bills fully 50%. Since October 22, 1920, the coal companies have been compelled to pay schedule rates for their power, as the Public Utilities Commission abrogated all 'special' contracts on that date. It is believed that a power-plant can be constructed at a cost of \$1,000,000 that will supply the principal coal producers with power. It is proposed to use slack coal, now being sold at a loss, in the generation of steam. It is also stated that the metal-mining companies in the Park City district have been giving attention to the question of a joint power-plant in that vicinity for the purpose of supplying power at a lesser rate than they are now compelled to pay to the Utah Power & Light Co. Attorneys for the Utah Copper Co. recently declared that that company could produce its own electric power in a steam-plant for 30% less than the existing rates as sanctioned by the Utilities Commission.

ARIZONA

Bisbee.—Twenty feet of high-grade sulphide ore has been cut in an intermediate drift between the 600 and 700-ft. levels of the Boras mine since January 1, when ore shipments from the Boras were discontinued. The shaft has been sunk 100 ft. and a drift has been run to a point under the orebody discovered on the 600-ft. level. A raise and drift have developed the ore. M. J. Elsing is manager for the company.—In the adjoining Nighthawk mine a cross-cut from the main drift on the 650-ft. level penetrated rich sulphide ore some weeks ago. The ore contains bornite and is rich in silver. James McKenna is superintendent.

Dos Cabezas.—Unusually fine ore has recently been opened by the Le Roy Consolidated Mines Co. The extent of the shoot has not yet been determined, as only a small amount of drifting has been done. A small force of men has been employed in development work for over a year. The ore is high-grade, containing gold, silver, and lead.

Hayden.—The Ray Consolidated Copper Co. milled 347,-

778 tons of ore, averaging 1.641% copper, during the first quarter of 1921, and the average extraction was 77.09%. The production of copper from concentrates was 8,802,186 lb. and from direct smelting are 144,339 lb., making a total production of 8,946,525 lb., as compared with 10,617,651 lb. for the preceding quarter. The average net cost of production was \$5.65c. per pound of copper.

Kingman.—Renewed work on the 700-ft. level of the Aztec claim of the Tom Reed Gold Mines Co. has opened high-grade milling ore. This shoot was first opened two years ago, but the flow of water was so great as to cause discontinuance of the work.

The Arizona Rand Gold Mine Co. has let a contract for 250 ft. of work on the 100-ft. level of the Roadside mine to R. W. Shaw. Unwatering and timbering are now being done in preparation for drifting, which will be commenced within a week. The Roadside mine is situated in the Puleon Pass district.

The shaft of the Katherine Extension has now entered lode-matter for a depth of 20 ft. Overburden proved to be only 100 ft. thick. The shaft is to be continued to the 200-ft. level, from which point lateral exploration will be done.

The ore in the east drift on the 700-ft. level of the Gold Ore shows a width of 5 ft. and assays as high as \$20 per ton. The drift has now been carried 125 ft. in the vein, which has continued to widen. Negotiations are under way to raise sufficient money to sink to the 800-ft. level. It is stated that the present orebody is as large as any opened to date in the Gold Ore mine.

Drifting on the 100-ft. level of the Dardanelles mine has opened 30 in. of ore which assays \$37 to \$40 per ton. This high-grade streak is in a 12-ft. vein. A raise from this level to the level above is now being run in good ore. Two cars of ore are now ready for shipment to the smelter.

The Katherine Mohawk Mining Co. has secured a permit to sell 200,000 shares of treasury stock. The property of this company approaches within 600 ft. of the Katherine mine, in which large bodies of high-grade gold ore have been recently opened; it is located on an outlying vein.

Morenci.—The Arizona Copper Co. ceased operations on May 31. The Arizona is the last copper company in the Clifton-Morenci district to suspend operations, the Phelps Dodge having closed a month ago. The Stargo silver mine is operating a small force and contemplates the erection of a mill.

Tombstone.—Charles P. Blanton has acquired a group of claims known as the Gold Camp, situated 16 miles north of here. He will develop the property at once. Other claims are being prospected in the vicinity.

Notices of sheriff's sale have been posted for the sale of nine claims of the Dragoon Copper Mining Co. The sale is to satisfy a judgment secured by W. J. Smith for \$850.

Messrs. Hammond and Sibling of the New Mining & Milling Co., who are to operate the mines and dumps of the State of Maine mine, have arrived at Tombstone and are to commence construction immediately. These gentlemen and associated Tucson interests are behind the undertaking.

CALIFORNIA

Carrville.—The Coffee Creek Gold Mining Co. has been incorporated by C. J. Kerr, W. A. Crank, and Lawrence J. Kennedy. An option has been taken on the Golden Jubilee mine on Coffee creek.

Forest.—Construction work on the new 10-stamp mill at the Kate Hardy mine is progressing steadily. Orders have been placed for the 1250-lb. stamps and other machinery for the mill and for the entire amount of lumber needed in the construction of the plant. It is hoped to have the mill running early in July. All the bins of the mine are filled with broken ore ready to be crushed, so very little underground

work can be done until the mill is put in condition to handle the ore.

Grass Valley.—The managers of the three leading mines published a letter on June 2, addressed to the Mine Workers' Protective League, stating that the mining problem here had resolved itself into a question of lower operating costs or closing the mines.

It is announced that a lower wage scale will be effective July 1. No specific cuts are mentioned, but it is pointed out that the mines on the Mother Lode have adopted a wage-scale based on \$4 per day for miners and \$3.50 for shovelers. This is about \$1 per day under the scale now in effect. The statement, which is signed by George W. Starr for the Empire Mines, A. D. Foote for the North Star Mines, and John A. Fulton for the Idaho-Maryland Mining Co., gives a long review of mining conditions here and intimates that heavy losses have been sustained in an effort to keep the mines open and the men employed. For a time it was hoped that the McFadden Bill would bring relief, it is stated, but the producers are now convinced that Congress does not intend to come to their rescue. The necessity of working both low-grade and high-grade ore as it is encountered, instead of 'robbing the mine' by taking out only the high-grade ore is pointed out. The statement closes by saying: "It is the expectation of the management that the employees will recognize the fact that a reduction in the scale of wages will be made reluctantly and only after the failure of every other means of relief from the condition which now jeopardizes the gold-mining industry". All of the mines of this vicinity will be affected by any change in scale, and approximately 1000 men are involved.

The Mine Workers' League made a statement that is replete with sarcastic references and pokes fun at the version of the mine-owners concerning the need of extracting both high-grade and low-grade ore.

The outcome of the exchange is expected to be the appointment of committees to confer concerning a wage-scale to take the place of the one now in force and which will expire on July 1.

The Empire Mines Co. for the present has suspended operations at the Pennsylvania mine. F. W. Nobs, superintendent, states that the ore available is too low-grade to be profitably mined under present conditions. Large deposits exist which may be mined at a later date.

Magalia.—B. Wisebaum, who controls the old Steifer gravel mine, has unwatered the 500-ft. shaft and has 30 men employed. After obtaining millions from the mine, the Steifer brothers lost the 'lead' and for years endeavors to again find the goldbearing strata were unsuccessful.

Melones.—During April, the Carson Hill Gold Mining Co. crushed 15,000 tons of ore at a total mining and milling cost of \$3.74, as compared with \$4.10 during February. It is expected that the cost for May will not be more than \$3.50 per ton. Work on the 2000-ft. level is progressing satisfactorily, and the workings should soon reach a point under the orebody developed on the 1700 and 1750-ft. levels; a raise will be started to develop the ore.

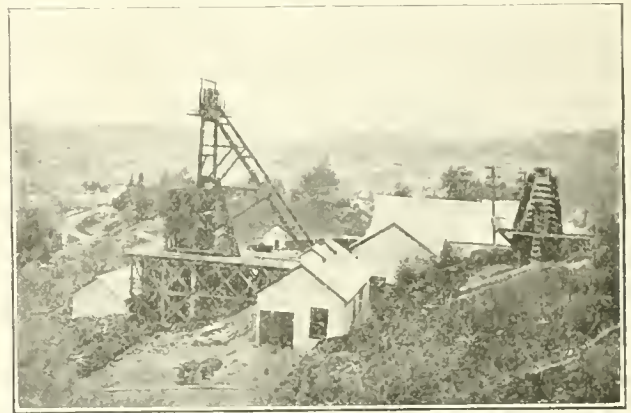
Portola.—Three gold bars, valued at \$6720, were sent to the United States Mint at San Francisco, and forty cars of concentrate, with a total value of \$5000, were shipped to the smelters in Salt Lake valley from the Gruss mine. This represents the output for 28 days during May; the bullion is from the first clean-up since the installation of the new electric equipment. During the month, 1400 tons was mined and milled at a combined cost of \$2.25 per ton, according to J. W. Gruss, manager. He states that during the last three months, development work has disclosed two new glory-holes containing \$8 ore.

Quincy.—The 10-stamp mill of the Schaffer Consolidated Gold Mining Co., at Seneca, has been fully repaired and is

again in operation. This property is considered to be one of the best gold-quartz mines in Plumas county, and a large amount of gold has been taken from it. Development work has been carried on all winter and high-grade ore is blocked-out. Eastern capital is behind the corporation. J. J. Reilly is in charge of operations.

The Reinmiller Copper Mining Co. has resumed work at its property, adjoining the Engels mine, after an idle period of several weeks. Diamond-drilling has given satisfactory results. The last hole drilled showed low-grade ore within 50 ft. of the beginning of the hole. A nine-foot core gave an assay of 3.166% copper. John Reinmiller is personally directing the work, after an illness of several months.

Representatives of the Mason Valley Smelter Co. are at their property near Genesee, which they have under bond and lease from Rufus Barnes and J. E. Murphy. Last fall a road was built to this property from the main highway, a camp was built, and everything placed in readiness for development work this spring. This property lies within five



The Old Eureka Mine at Sutter Creek

miles of the Walker mine, on the southern end of the copper belt.

Development work is also being done at the Ruby copper mine, and the Feather River Copper Co.'s property, adjoining the Engels mine on the south. Messrs. Long and Melver of Arizona are interested in these two properties. J. E. Bush is manager of the Feather River mine, and Lester Williams is in charge of the Ruby property.

Redding.—The offices, store, and staff headquarters of the Mountain Copper Co. have been moved from the Iron Mountain mine to the Hornet mine, two miles distant. Only one train daily is run over the Iron Mountain railroad, now that the output of the Hornet has been curtailed to 300 tons per day.

Sonora.—Sale of the famous Excelsior gold mine for \$19,000 to J. W. Crossman and associates, of San Francisco, has been announced by the former owners, Sarah A. Hall and Fred Sutton, of Sonora. The new management has arranged to prospect for the rich shoot that faulted several years ago.

Sutter Creek.—The suspension of operations at the Old Eureka mine, recently announced, comes after an expenditure of more than \$1,000,000 in the purchase of property, the equipment of the mine with modern machinery, and the sinking of a 1000-ft. shaft. Extensive development work, however, failed to uncover the expected ore. The mine is credited with a yield of more than \$20,000,000. The property was formerly owned by Hetty Green of New York.

COLORADO

Alma.—Mining activity in the Alma-Sacramento district is steadily increasing with more properties active than be-

fore the War. Operations were resumed at the Brownlow a few weeks ago and a lode 24 ft. between walls has been opened by cross-cut tunnel. Indications for finding ore are good.

A hydraulic-placer plant has been installed in Buckskin gulch; washing started on June 1.—Operations have been resumed in the Mascotte tunnel, planned to penetrate the Mosquito range for drainage, transportation, and mining purposes. Several veins have already been cross-cut and will later be developed.—The Dolly Varden and Moose mines are being prepared for resumption.—The Hill Top will resume shipments when metal prices improve. A small shipment recently sent out from the Champaign returned better than \$1000 per ton in silver and gold.

Breckenridge.—Many properties closed down during the winter have resumed or are preparing to resume operations. Among these the Tymos Mines Co. is installing a pumping plant at the Deep shaft on Shock hill. The Warrior Mark company is unwatering the old Kaiser shaft, where a vein of silver-lead ore was uncovered when the shaft was last worked in the '80s. Lessees on the Missouri who were driven out by seepage from the melting snows are also preparing to resume. This lease has around 100 tons of lead carbonate ore on the dump awaiting a higher market. The King Solomon Mining & Development Co. is making preparations to resume on its property below Breckenridge at Frisco; the tunnel is to be extended. The June Bug lessees will make a shipment of high-grade silver ore from this Prospect gulch property later in the month, estimated at better than 300 oz. per ton. One of the Standard mine lessees will make a 50-ton shipment to the A. V. smelter at Leadville, estimated at around 100 oz., as soon as the road is in condition for hauling.

Cripple Creek.—George Bernard and associate lessees, who recently secured a long-time lease on the Elkton, has opened a new orebody in Raven territory north-west from the main shaft by a cross-cut at the 100-ft. level. This territory was productive above 600 ft., and the Elkton company was unable to prospect the ground on its own account through adverse financial conditions. Royalties paid on ore shipped are expected to place the finances of the company in sound condition.—Sub-lessees from the Victory Gold Mining Co. are mining ore averaging \$24 per ton and shipping from 4 to 6 cars per month from the Howard shaft of the Mary McKinney Mining Co.—Shipping of milling-grade ore from the Rittenhouse mine will be started by lessees now opening a promising shoot at the 400-ft. level.—The Ingham on Raven hill, owned by the Doctor-Jack Pot Mining Co. is again producing under lease.—Ore-reserves at the Cresson are steadily increasing and production continues heavy. The treasury reserve is building up but no dividend is anticipated until tax-rulings are adjusted.

Silverton.—The San Juan Golden Fleece Mining Co. has acquired additional lode claims on Treasure mountain adjacent to the Golden Fleece and is making arrangements for their development. Adits already started have exposed known producing veins in nearby properties and samples taken have assayed from \$20 to \$62 silver with fair gold content.

IDAHO

Coeur d'Alene.—According to reports received at Spokane, Portland parties have taken an option on one-half of the capital stock, consisting of 1,000,000 shares valued at \$150,000, of the Sonora groups at Burke, situated near the Hecla and Hercules mines.—Lessees working on the No. 3 tunnel of the Western Union mine are re-timbering a raise and as soon as work is finished will resume shipments. Another car of high-grade ore was recently shipped by the lessees working on No. 4 tunnel. They are running a cross-cut to the north vein, where still better ore is expected, as

ore in this vein found on the No. 3 level by the old H. E. M. company was the best it had.—Seams of ore in a strong vein are reported in the face of the west drift in the Cedar Creek property. Work was resumed a few weeks ago.

Development has been resumed by the Rex Consolidated Mining Co. The Okanogan vein, parallel to the Rex, is the objective of the present work. It will be reached by a cross-cut from the Rex workings. Two shifts are working.

Directors of the Hecla Mining Co. have declared a dividend of 5c. per share and voted to join with officials of the Bunker Hill & Sullivan company in the purchase and development of the property of the Star Mining Co. Eight cents per share amounts to \$80,000, the first dividend the company has paid this year. The Star is considered one of the great undeveloped mines of the Coeur d'Alene. It adjoins the Morning mine owned by the Federal Mining & Smelting Co. Between the Star and Federal companies a suit was tried to determine the ownership of ore which the Star claimed the Morning mine had taken out of Star ground. The Star won and the Morning must pay a large sum for the ore extracted. The value of this ore is yet to be determined, but it is estimated at between \$500,000 and \$1,000,000. The Bunker Hill & Sullivan and the Hecla have been working in close harmony for several years, the former company smelting the ores of the Hecla. The Star deal brings the two companies closer together.

MICHIGAN

Houghton.—Quincy is maintaining its four-day-per-week schedule and is down to the lowest possible minimum of production, getting out not much more than a quarter of the normal amount of rock. A good mass-copper yield has aided materially in reducing costs and with mill improvements and economies effected the cost per pound is now down to 14½c. as compared with 19.16c., including construction, for the year 1920. With a reduction this year in the price of coal and other materials, cost could be reduced to nearer normal, owing to the fact that wages are back to practically a pre-war basis. Quincy costs in 1916 were 12.58c. per pound, and 9.64c. in 1915. In the Quincy stamp-mills, where the installation of re-grinding equipment resulted in a saving of 2,345,000 lb. of copper last year, all but one unit have been supplied with re-grinding sections. When that unit is so equipped a still larger recovery will be possible. Coupled with this saving is the increase in yield, which was 3.47 lb. greater in 1920 than in 1919. The tenor of the 'rock' in the present openings and slopes gives assurance that this yield can be maintained.

The district appears to be weathering the depression caused by the shutting down of the Calumet & Hecla and its subsidiaries without any noticeable distress. A composite report of the banks of the 'Copper Country' shows only a negligible falling off in deposits, the total now being \$19,169,254. It is due to the fact that the miners as a class have been thrifty and have some money saved up that they have managed to get along to date. There have been no failures among the business houses and the situation generally is better at this time than had been expected. Approximately \$600,000 will be spent on road work this year and this will provide jobs for men most in need of them. The Calumet & Hecla is supplying its employees with land for garden plots and plowing the ground. Practically every family will raise enough vegetables for summer and winter use.

MONTANA

Butte.—It is reported that 6 ft. of high-grade copper ore has been opened on the 2300-ft. level of the Colorado mine belonging to the Davis-Daly company. Excellent ore is also coming from the Hesperus vein, being mined by lessees through the Butte-New England shaft just south of the Colorado.—An increased output of silver ore is reported

in the Butte district. In the Elm Orlu mine 20-oz. silver ore has been opened on the 800-ft. level. Effort is being made to find several rich ore-shoots on the 300-ft. level.

Cross-cutting on the 1600-ft. level in the Main Range mine of the Tuolumne Copper Mining Co. is progressing rapidly. The objective is the Spread Delight vein, which should be reached with another 150 ft. of driving.

Libby.—The Lukens-Hazel company is erecting a commodious boarding-house near its mill. Development work is being pushed rapidly. An underground station and hoisting plant for the sinking of a shaft were completed recently and actual work has been started. A depth of 250 ft. is planned.

St. Regis.—Gold ore assaying \$500 per ton is reported to have been found on the Democrat group of claims situated 5 miles south of here.

NEVADA

Eureka.—The 400-ft. Catlin shaft of the Eureka Croesus is to be sunk to 800 ft. This shaft, the main shaft for development and the extraction of ore, is equipped with machinery ample for sinking to this depth.

Goldfield.—The Florence company has suspended operations for an unannounced reason. The lessees continue work as usual. The stopping of work comes as a surprise, following as it does the optimistic statements of L. E. Whicher, president of the company, on a recent visit to Goldfield. Driving of a cross-cut west from the south-east cross-cut on the 358-ft. level was well under way when work was stopped and other prospecting on this level had been started. The Grandma has cross-cut 55 ft. east from the shaft on the 1000-ft. level toward the extension of an ore-shoot found in a winze from the 815-ft. level. The cross-cut is now in mixed shale and alaskite. The Great Bend, 214 ft. from the main raise from the 375-ft. level, has stopped work on the intermediate level. The intermediate level was being driven in the vein and as it was continued east the ground became so bad that work had to be stopped. Good assays were obtained all along this drift, but an orebody was not found. Work has now been started on the 375-ft. level, where a cross-cut is being driven north into the foot-wall of the vein. A drift will be driven east in this wall, with cross-cuts west into the vein at 50-ft. intervals.

Kennedy.—A shipment of five tons of silver ore from the Independence mine in the Kennedy district, 60 miles south of Winnemucca, had a gross value of \$185 per ton. The ore is quartz containing silver in both chloride and sulphide form. The vein, 3 to 4 ft. wide, is at a contact of lime and porphyry. No work has been done below a depth of 15 feet.

Lovelock.—Glenn D. Cook has found a body of high-grade silver ore 75 ft. from the surface of the Jersey claim belonging to the Pershing County Mines Co. The discovery seems to verify the diagnosis by Mr. Cook of the geology of the mining property and to warrant the sinking of a deeper shaft, which will be commenced at once.

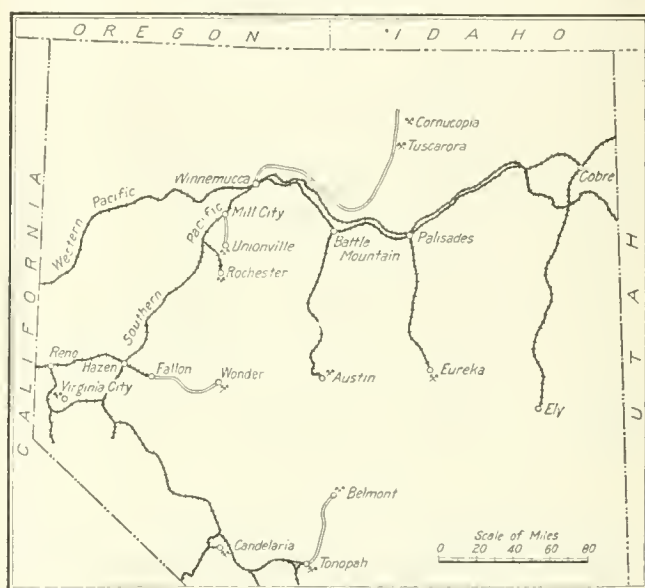
Round Mountain.—The flow of water into the reservoirs of the Round Mountain company has increased rapidly in the last two weeks and four giants are in use. Continued cold weather and snow through May make certain the longest season in the history of the company and assure a big return. About 75,000 cu. yd. has been treated to date and up to the middle of May the head-boxes had yielded \$41,000.

Silverhorn.—George Z. Smith has found remarkably high-grade ore on his No. 2 lease on the Nevada Silver Horn property. Specimens assay more than \$2000 per ton and a lens 10 ft. wide averages \$100 per ton. This rich ore is being sacked and shipped. Smith also has a lease on the Silver Dale. He has opened up an orebody but as yet has not found a high-grade streak.

Tonopah.—It is reported that 50 men are employed by the

Belmont, 50 by the Tonopah Extension, and that the Tonopah Mining has men enough to work on a good scale. In a statement issued to stockholders by the Belmont, announcing the passing of a dividend, Clyde A. Heller, president of the company, says: "The new wage-scale is absolutely necessary if the thousands of tons of low-grade ores available at your property at Tonopah are to be treated, thereby prolonging the life of the mine. Even with the reduction the new scale is higher than that of any other mining district in the country. There are many unemployed men in other districts and your property will be operated under the new scale as soon as labor can be brought in." More men are being brought into Tonopah now by the companies than at any time since the strike was declared. The strikers on the other hand are still confident they will win.

Tule Canyon.—The Silver Hills mill is now operating 24 hours daily and is making a recovery of 95%, according to reports, with the newly built cyanide plant working satisfactorily. A large amount of development work is being



Northern Nevada

done in various groups of claims owned or held under option by the Silver Hills.

Tybo.—A judgment for \$18,951 against the Louisiana Consolidated Mining Co. has been given in the district court at Reno in favor of an automobile agency that sold trucks to the company. S. R. Moore, of Tonopah, recently was appointed receiver for the company, which is reported to have liabilities of \$500,000, incurred in the attempts made in the last few years to put it on a paying basis.

Virginia City.—The new wage-scale, marking a reduction of 50 to 75c. per day, has been placed in effect on the Comstock Lode. All mines at Gold Hill and Virginia City are affected by the cut, which has been received without protest by most of the men. About 100 workers who refused to accept the reduction, all single men, have left for Reno and other points. Practically every mine in the district is working close to normal, with new men taking the places of those who walked out. Reductions in price of board and cost of commodities have been ordered by the United Comstock Mines Co., operating at Gold Hill. Establishment of the new scale means a considerable reduction of operating cost, and its acceptance proves the good feeling prevalent between employers and employees.

West Divide.—The West Divide is cross-cutting west from the bottom of a 63-ft. winze from the tunnel level to find the vein, which faulted at the 45-ft. point in the winze. A

cross cut driven east from the winze failed to enter the vein, but it is the opinion that it will be found to the west. There was ore in the winze to the 45 ft. point.

Winnemucca.—A rich silver discovery is reported from the Mount Tobin district, 60 miles south of Winnemucca, between Pleasant and Jersey valleys. Two veins, one 60 ft., the other 16 ft. wide, have been uncovered at surface and traced for 300 feet.

UTAH

Park City.—Owing to the controversy between the A. S. & R. Co. and the Silver King Coalition Mines Co., no shipments of ore were made by the latter company during the week ended May 28. For the same reason, no shipments were made by the Daly-West Mining Co. The result was that shipments from this camp for the week ending May 28 totaled but 993 tons, of which the Ontario shipped 438 and the Judge allied companies 555. On June 1, the Silver King Coalition resumed shipments to the Murray smelter, although the differences between it and the A. S. & R. Co. were reported as not having been "entirely adjusted".

American Fork.—W. A. Richmond, mining engineer for the American Leasing Co., which is operating the Bellorphan property in American Fork canyon, reports that the company has opened a promising orebody, running, in picked samples, up to more than \$400 per ton and averaging around \$40 per ton. This ore comes from a vein about 1200 ft. from the portal of the adit, and at present has a width of above five feet, carrying silver, lead, and copper.

Beaver County.—Operations have been resumed by the Galena Mining Co., whose property adjoins the Beaver Copper mine, according to M. C. Morris, president. Contractors are at work driving a tunnel to catch the ore that was developed in the Galena shaft at a depth of about 240 ft. The tunnel is now in 260 ft. and should find the ore within the next 150 feet.

Big Cottonwood Canyon.—Hauling of ore from the bins of the Cardiff Mining company to Salt Lake Valley smelters was started on June 1. All ore mined by the company since last fall has been stored, 2000 tons is awaiting shipment. Conditions at the mine are reported as excellent. Last summer the company mined from 50 to 60 tons per day, averaging around \$50 to \$60 per ton.

Bingham.—Eighteen students of the State School of Mines, under the direction of Prof. Howard L. Baldwin, are taking a four weeks course in 'practical' mining in various mines in this camp. The students will spend some of their time in surveying claims on the surface, but the main object is to become familiar with practical underground operations.

The Utah Copper Co. is doing churn-drill work for the purpose of developing more fully the ore deposit near its northerly boundary. This work could not be undertaken before, owing to interference of steam-shovel operations. The company also has one steam-shovel at work, making a new entrance into the 'big pit' from the auxiliary yard. This work is being done by the company forces that were retained on the payroll when active mining ceased on April 2.

Exceptions of the Utah-Apex Mining Co. to the accounting filed by the Utah Consolidated Mining Co. were submitted to the United States District Court on May 31. The statement filed by the Utah Consolidated showed the value of the ore extracted, plus interest, to be \$658,000, whereas the Utah-Apex claims the amount to be \$1,421,467.88.

Ophir.—There is more activity here than for a number of years past. Recently a find of four feet of high-grade ore was made at the Ophir Silver Mines Co.'s property. This strike is in the upper tunnel on Claim No. 13, in what is known as the 'second Buckhorn' fissure, which is easily traceable from the Ophir Hill Consolidated property across

the canyon. The fissure is widening with depth, and sinking on the ore has begun. One sample gave returns of 152.5 oz. silver and 5.17% copper, although the average for the entire face is about 50 oz. silver. George H. Short, of Salt Lake City, is geologist and consulting engineer for the company. George St. Clair has taken a lease on the Buffalo Consolidated property. A good showing of silver-lead ore has been opened at a distance of about 1000 ft. from the portal of the adit. A shipment of 100 tons, averaging \$5 in gold, 40 oz. in silver, and 40% lead, is piled upon the dump, awaiting transportation to the smelter. In the Pink property high-grade silver-lead ore was recently opened. The Ophir Hill Consolidated mine and mill, owned by ex-Senator W. A. Clark, is now being operated on a one-shift per day basis. The company has a large tonnage of concentrate stored, awaiting better lead prices.

WASHINGTON

Colville.—The Chloride Queen mine, 14 miles north-east of here, is attracting attention. Five claims are included in the holdings of the company. A vein 25 to 30 ft. wide goes through the property. It contains streaks of rich galena-bearing material from a few inches to five to six feet wide. At one place a carload of ore was taken out and shipped, returning \$62 per ton. On the dump is approximately 5000 tons of ore estimated to assay \$22 per ton. Paul LePlant, superintendent, is directing development.

Oroville.—Smelter returns averaging 14 ounces more in silver than mine assays on a carload of ore shipped from the Pyrrargyrite mine has encouraged a renewal of mining activity in this district, according to reports.

Stevens County.—Articles of incorporation have been filed for the Admiral Consolidated Mining Co., which has consolidated the Admiral and Denver properties. Arthur L. Hooper of Spokane is president. Work has been commenced on a new tunnel on the north end of the property. The hill is very steep and a 50-ft. tunnel is expected to give 150 ft. of depth. The ore is copper and silver. Two carloads shipped returned 6% copper and 7 oz. silver. Mr. Hooper is secretary-treasurer of the General Copper Mining Co., which owns property a mile north of the Admiral. Recently four feet of ore was uncovered on the surface, select samples from which run 6% copper and 5 oz. silver. The company will sink a 100-ft. shaft to explore this ground.

BRITISH COLUMBIA

Greenwood.—Work has been resumed at the Providence mine, after a shut-down of six months. The new compressor is in operation, and 25 men are employed underground.

Prince Rupert.—Pat Daly, the picturesque prospector of the Kootenays, who 'blew into' the Pennsylvania hotel, in New York, recently, minus many of the usual appurtenances that are supposed to constitute respectability, reports by wire that he has succeeded in bonding the Big Missouri, in the Salmon River district, and the Fraser, in the Marmot River district, and that substantial deposits have been put up. The Big Missouri is owned by Dan and Andy Linderborg, of Hyder, and during the whole of last season was bonded by Dan Mann and associates, who did a considerable amount of diamond-drilling and other exploratory work before relinquishing the option.

Revelstoke.—The Walters Investment Co., of Spokane, has purchased the Waverly-Tangier group, at the head of Downie creek, 28 miles north of Albert Canyon, on the C. P. R. main line, and a substantial payment has been made to bind the deal.

Vancouver.—Many Government geologists have arrived from Ottawa to undertake field work in various parts of the Province. Among the assignments for the coming summer

are the following: Victor Dolmage will make a survey of the Mainland channel from Burke channel to the north of Royal island. W. E. Cockfield will again make his headquarters at Mayo; this is his eighth season in the Yukon. F. H. McLaren will investigate the oil-shales that have been attracting some attention on Graham island, one of the Queen Charlotte group. S. J. Schofield will cover the Windermere district. W. L. Uglow has been assigned to a section of the North Thompson river. M. F. Bancroft will continue his investigations in the Lardeau district, while William Johnston goes to the Cariboo district. J. D. McKenzie, who is in charge of the local branch office, will study the coal deposits at Comox and the gulf islands. G. Hansen will cover the Kitsault river and other parts of the Alice Arm district.—The Granby Consolidated Mining, Smelting & Power Co. held its annual general meeting recently; the annual report was not ready in time for the meeting but it was announced that the operations for the year would show a deficit, as the actual production of copper has cost slightly more than 12c. per pound, to which cost of transportation and marketing has to be added. During the last half of the year the cost of production was reduced 0.4c. The ore-reserve on December 31 was 10,986,420 tons, showing a depletion of 200,000 tons, which it is explained was caused by the effort to push production at the neglect of development in the early part of the year, when the price of copper was satisfactory, but had every indication of a fall. During the year 27,000,000 lb. of blister was produced and 25,000,000 lb. refined. The stock on hand at the end of the year was 20,000,000 lb., 3,000,000 of which was in process. The sales totaled 19,464,000 lb. Labor conditions were reported to be good, and rapidly approaching pre-war efficiency.

MEXICO

Arizpe.—Last month ore from the Chispas vein on the 900-ft. level of the Pedrazzini mine was found for the first time. Development to date has proved it to be of bonanza grade. It is expected to be more productive than the \$42 bonanza pocket of the 800-ft. level. Drifting on the 900-ft. level, the present mine bottom, was started during last December; the first 160 ft. was driven upon a barren quartz vein jumping suddenly into first-class ore. The vein now averages nine feet in width and the ore produced, after sorting the waste by hand, averages over 300 oz. per ton in silver. Fernando Montijo is engineer for the company.

Chihuahua.—Large bodies of rich silver ore are being opened in the mountains east of Villa Ahuamada, the first Mexican town south of El Paso on the old Mexican Central railroad. The ores from this district are said to be similar in character and quantity to those in the old Santa Eulalia district that made Chihuahua famous as a mining centre. Recently large bodies of lead carbonate ore with high silver content have been shipped.

Durango.—The Sauces Mining & Milling Co. is erecting a new 100-ton concentrating mill at its Conde mine. This company is developing and making some shipments of dry silicious ore to the Chihuahua smelter. The ore will be treated on the ground as soon as the mill is complete. The long overland haul to the railroad station coupled with the high freight-rate greatly reduces the profit.

The Melchor Ocampo Mining Co., of which Attorney Jose Zurita is president, is completing a concentrating plant and has installed Stein flotation machines. This mill will shortly be in operation. The mines and mill are situated at Tejamén, about two days journey by pack animal over a rough trail from the Tejamén station. The machinery and equipment for the new mill were hauled over the trail in small parts requiring much time and expense.

San Juan de Guadalupe.—Albert Bange who has been operating his silver-lead mines in the Ramirez mountains

without interruption during the past fifteen years continues to ship to the Aguascalientes smelter which is operating two copper furnaces and preparing to blow in one lead furnace. —Capillas Rueda is working his mines in this district and shipping some high-grade silver-lead ore to Chihuahua. He expects to change these shipments to the Aguascalientes smelter as soon as the lead furnace is started.

Zacatecas.—August Reimers has filed on the Santa Barbara group of mines located in the municipality of Guadalupe. The property contains a vein of high-grade silver ore; a shaft is to be sunk.—Walter Palmer is working a large force of miners at his Parroquia mine. He is shipping about 150 tons of copper-silver-lead ore to the Aguascalientes smelter per week. At the present time this is the only mine of importance which is working near the city of Zacatecas. The Bote Mining Co. is doing some development work and repairing its cyanide plant but is not shipping at the present time.

ONTARIO

Beaver House Lake.—J. H. Rainville, president of the Argonaut, who has returned from a visit to the mine, reports that work at the 355-ft. level is meeting with excellent results, one vein having been cross-cut showing ore averaging \$27 per ton.

Cobalt.—The Mining Corporation of Canada has resumed operations at full capacity on its Cobalt properties, giving employment to about 240 men. Before closing down in January last the management had succeeded in reducing operating costs to 60c. per ounce, and having enlarged its mill capacity by about 50% the Corporation expects to be able to effect further economies and produce silver at a profit at present prices.

Options held by the National Mining Co. on the section of the Silver Cliff property below the 500-ft. level, and by the Northern Customs on the upper part of the mine, have lapsed and a plan of exploitation and development by Silver Cliff interests is in contemplation.

Kirkland Lake.—At the Ontario-Kirkland about 3500 ft. of drifting has been done on the 300 and 450-ft. levels, and about three years supply of ore is indicated. A three-compartment shaft, to be used as the main working shaft, is being raised from the 300-ft. level and about 100 ft. is completed. The construction of the mill is expected to be completed by September 1.

Buildings are being erected on the property of the Kirk Gold Mines, adjoining the King-Kirkland in the central part of Lebel township preparatory to surface exploration. The Kirk Gold is in the line of the strike of a promising vein on the King-Kirkland.

It is reported that a recent find at the 900-ft. level of the Kirkland Lake mine is regarded as important. Frank L. Culver, president, states that a diamond-drill driven horizontally passed through between 11 and 12 ft. of ore, 2 ft. of which assayed upward of \$60 per ton and 7 ft. contained an average gold content of \$20 per ton.

Matachewan.—Asbestos mining is in progress in Bannockburn township in the Matachewan gold area. Fifteen men are at work in charge of William Judge. For a preliminary test 30 tons is to be taken out and shipped. The district is handicapped by isolation from railroads.

Porcupine.—The Hollinger Consolidated is making a preliminary survey of the Kettle Falls water-power on the Abitibi river, 60 miles to the north, with a view to securing a supply of power.—Work has been started on the Big Dike, about four miles south of the Dome, by a small force under the direction of F. G. Heycke.

West Shining Tree.—The Wasapika Consolidated has ordered machinery for a 100-ton mill, which it is hoped to have ready for operation before the end of the year.

PERSONAL

The Editor invites members of the profession to send particulars of their work and appointments. The information is interesting to our readers.

Frank L. Sizer has returned from Colorado.

J. M. Callow, of Salt Lake City, is in New York.

W. J. Loring was at Kingman, Arizona, recently.

Mark L. Requa is at the Adler Sanatorium, having undergone an operation.

Spencer Bishop has moved from Clifton, Arizona, to Berkeley, California.

Harry H. Stewart, of Deadwood, is now assayer of the Deadwood assay-office.

Richard M. Geppert sailed from New York on the 'Adriatic' on June 1 for London.

C. W. Whitley, vice-president of the American Smelting & Refining Co., is at Salt Lake City.

Claude Ferguson has moved from Swansea, Arizona, to Oso, in Shasta county, California.

Girard R. Rosenblatt has returned from a trip through Utah, Montana, Idaho, and Washington.

Hjalmar E. Skogor has returned to New York from Europe after an absence of three months.

Louis S. Cates, general manager for the Ray Consolidated Copper Co., is spending a few weeks at Boston.

Herbert R. Hanley has returned to Bakersfield, California, from an examination of the Silver Horn region near Pioche, Nevada.

J. C. Johnson, who has been at Miles City, Montana, now has an office as mining engineer and geologist at 600 Leary building, Seattle.

Newton A. Danyon, superintendent for the Ontario Silver Mining Co. at Park City, Utah, has returned from a trip to Pioche and Silverhorn, Nevada.

J. R. Hockey, superintendent of iron mines for the Broken Hill Proprietary Co., arrived at Vancouver from Australia on May 28, on his way around the world.

Isaac H. Smith, of Peekskill, New York, has been appointed superintendent of the New York assay-office, succeeding Verne M. Bowie, who has resigned.

C. R. Forbes, Professor of Mining at the Rolla School of Mines, accompanied by a party of students, has been visiting mining districts in Arizona, New Mexico, Colorado, and Utah.

H. C. George, formerly chief engineer for the Wisconsin Zinc Co., has accepted the position of oil-recovery engineer with the U. S. Bureau of Mines, with headquarters at San Francisco.

H. H. Stout has resigned from his position as superintendent of the Copper Queen smelter to become consulting metallurgist for the Phelps Dodge Corporation, with headquarters at 99 John street, New York.

W. R. Appleby, Dean of the Minnesota State School of Mines at Minneapolis, accompanied by W. R. Emmons, Professor of Geology at the same institution, sailed from Seattle on June 3 for China on professional work.

Murray Innes, who for several years has been general manager of the New Idria quicksilver mine, was seriously injured on June 6 as a result of an accident that took place at California and Montgomery streets, San Francisco.

Howard R. Ward has removed his office to the Manufacturers Exhibition building, 45 West 18th street, New York, where he will continue his engineering practice, specializing in mine examination, and in the development and operation of non-ferrous metal mines.

Henry F. May, for the past three years special assistant to the attorney general in charge of litigation over the withdrawn oil lands, has opened an office for the general practice

of the law, in association with Charles S. Wheeler and Charles S. Wheeler, Jr., at 609 Nevada Bank building, San Francisco.

C. A. Fisher, of the firm of Fisher & Lowrie, consulting geologists and engineers, of Denver, Colorado, has recently been appointed a delegate by the American Petroleum Institute to the first annual meeting of the International Chamber of Commerce to be held in London from June 27 to July 2. He sails from New York on June 14.

Obituary

Karl G. Roebbing, president of the John A. Roebbing's Sons Co., died at Trenton, New Jersey, on May 29.

Union Worthington, for thirteen years Chief Surgeon for the Utah Copper Co. and the American Smelting & Refining Co. at Salt Lake City, died at Santa Monica, California, on May 30. He was born at Danville, Kentucky, 59 years ago. He came to Salt Lake City in the early '90s and was associated with Dr. H. S. Pinkerton, Chief Surgeon for the Oregon Short Line. In 1907 he formed a partnership with Dr. A. L. Castleman, and since that time this firm and its associate physicians have had full charge of the medical and surgical work of the Utah Copper and A. S. & R. companies. Last fall, owing to failing health, Dr. Worthington retired from professional practice and moved to southern California. Tuberculosis was the cause of his death. He is survived by his wife and two children.

Frank Allen Keith, prominent mining engineer, died on June 2; his many friends will be shocked and grieved to learn of his death. His professional contemporaries will miss his ability and judgment in the undertakings with which he was associated. He possessed one of those rare, delicate, considerate, and thoughtful natures that makes a large circle of friends without effort—they come inevitably on account of a cheerful, happy, and generous nature. He was anxious that others, especially the younger men, should share in his successes. He was born in 1870, at Detroit, Michigan, the son of John Wallace Keith and Fannie Louis (Allen) Keith. He was educated in the public schools of Detroit and at St. Paul's Academy, of that city. Immediately after concluding his studies he went west, to Colorado, where he became surveyor for the Iron Silver Mining Co., at Leadville. This was the beginning of a life that has been spent in mining and engineering work in Colorado, Utah, Nevada, and California. After leaving the Leadville company, he held successively the following positions: engineer of the Eureka Hill Mining Co. at Tintic, Utah; ore purchaser for the Arkansas Valley Smelting Co. at Leadville; assistant manager, Union Smelting Co. at Leadville; engineer, De Lamar Nevada Mines Co., in Nevada; general superintendent of the Bamberger De Lamar Mines Co.; engineer, Guggenheim Exploration Co.; general manager, Tonopah Mining Co., of Nevada. These firms are among the most important in the mining industry of America, and the offices he occupied have been among the most responsible. He remained in Nevada until 1908, when he moved to San Francisco, where he opened offices as a general mining engineer. After two years he moved to Los Angeles. One of his first mining ventures thereafter was the organization of the Pacific Mines Co., which he managed successfully for a number of years and until its sale to others. A short time later he became interested in Oatman, and through his activity the United Eastern mine was developed and brought to satisfactory production. He resigned the presidency of this company on account of ill health. He was never able to resume his full business activities and during the past few months has been confined to his home. He married Susan Banwell in 1896, at Chicago, Illinois, and there are two children, Frank Allen, Jr., and John Banwell Keith.—S. W. M.

THE METAL MARKET



METAL PRICES

San Francisco, June 7

Aluminum-dust, cents per pound.....	75
Antimony, cents per pound.....	6.75
Copper, electrolytic, cents per pound.....	13.00—13.50
Lead, pig, cents per pound.....	5—6
Platinum, pure, per ounce.....	\$75
Platinum, 10% iridium, per ounce.....	\$105
Quicksilver, per flask of 75 lb.....	\$50
Spelter, cents per pound.....	7.50
Zinc-dust, cents per pound.....	9.00—9.50

EASTERN METAL MARKET

(By wire from New York)

June 6.—Copper is quiet and easy. Lead is inactive and declining. Zinc is dead and lower.

SILVER

Below are given official or ticker quotations for silver in the open market as distinguished from the fixed price obtainable for metal produced, smelted, and refined exclusively within the United States. Under the terms of the Pittman Act such silver will be purchased by the United States Mint at \$1 per ounce, subject to certain small charges which vary slightly but amount to approximately three-eighths of one cent. The equivalent of dollar silver (1000 fine) in British currency is 46.65 pence per ounce (925 fine), calculated at the normal rate of exchange.

Date	New York cents	London pence	Average week ending	Cents	Pence
May 31.....	57.50	33.75	Apr. 25.....	60.22	34.77
June 1.....	57.75	33.50	May 2.....	60.68	34.76
" 2.....	57.63	33.50	" 9.....	61.58	35.08
" 3.....	58.12	33.87	" 16.....	60.41	34.42
" 4.....	57.75	33.87	" 23.....	58.93	34.46
" 5 Sunday.....			" 30.....	58.15	33.60
" 6.....	57.37	34.00	June 6.....	57.68	33.75

Monthly averages			1919			1920			1921		
Jan.	141.12	132.77	65.95	July	106.36	92.04	....	....	....	....	....
Feb.	101.12	131.27	59.55	Aug.	111.35	90.23	....	....	....	....	....
Mar.	101.12	125.70	56.08	Sept.	113.92	93.66	....	....	....	....	....
Apr.	101.12	119.56	59.33	Oct.	119.10	83.48	....	....	....	....	....
May	107.23	102.69	59.90	Nov.	127.57	77.73	....	....	....	....	....
June	110.50	90.84	....	Dec.	131.92	64.78	....	....	....	....	....

COPPER

Prices of electrolytic, in cents per pound.

Date	Average week ending	Cents	Pence
May 31.....	Apr. 25.....	12.50	12.50
June 1.....	May 2.....	12.37	12.37
" 2.....	" 9.....	12.46	12.46
" 3.....	" 16.....	12.50	12.50
" 4.....	" 23.....	12.89	12.89
" 5 Sunday.....	" 30.....	13.25	13.25
" 6.....	June 6.....	13.08	13.08

Monthly averages			1919			1920			1921		
Jan.	20.43	19.25	12.94	July	20.82	19.00	....	....	....	....	....
Feb.	17.34	19.05	12.84	Aug.	22.51	19.00	....	....	....	....	....
Mar.	15.05	18.49	12.20	Sept.	22.10	18.75	....	....	....	....	....
Apr.	15.23	19.23	12.50	Oct.	21.66	16.53	....	....	....	....	....
May	15.91	19.05	12.74	Nov.	20.45	14.03	....	....	....	....	....
June	17.53	19.00	....	Dec.	18.55	13.18	....	....	....	....	....

LEAD

Lead is quoted in cents per pound, New York delivery.

Date	Average week ending	Cents	Pence
May 31.....	Apr. 25.....	4.25	4.25
June 1.....	May 2.....	4.45	4.45
" 2.....	" 9.....	4.85	4.85
" 3.....	" 16.....	5.14	5.14
" 4.....	" 23.....	5.10	5.10
" 5 Sunday.....	" 30.....	5.02	5.02
" 6.....	June 6.....	4.90	4.90

Monthly averages			1919			1920			1921		
Jan.	5.00	8.05	4.96	July	5.53	8.03	....	....	....	....	....
Feb.	5.12	8.88	4.54	Aug.	5.78	9.03	....	....	....	....	....
Mar.	5.24	9.22	4.06	Sept.	6.02	8.08	....	....	....	....	....
Apr.	5.05	8.78	4.32	Oct.	6.40	7.28	....	....	....	....	....
May	5.04	8.55	5.01	Nov.	6.76	6.37	....	....	....	....	....
June	5.32	8.43	....	Dec.	7.12	4.76	....	....	....	....	....

TIN

Prices in New York, in cents per pound.

Monthly averages			1919			1920			1921		
Jan.	71.50	62.74	35.94	July	70.11	40.29	....	....	....	....	....
Feb.	72.44	59.87	32.16	Aug.	62.20	47.60	....	....	....	....	....
Mar.	72.50	61.92	28.87	Sept.	55.79	44.43	....	....	....	....	....
Apr.	72.50	62.17	30.36	Oct.	54.82	40.47	....	....	....	....	....
May	72.50	54.99	32.50	Nov.	54.17	36.97	....	....	....	....	....
June	71.83	48.33	....	Dec.	54.94	34.12	....	....	....	....	....

ZINC

Zinc is quoted as spelter, standard Western brands, New York delivery, in cents per pound.

Date	Average week ending	Cents	Pence
May 31.....	Apr. 25.....	5.29	5.29
June 1.....	May 2.....	5.49	5.49
" 2.....	" 9.....	5.45	5.45
" 3.....	" 16.....	5.41	5.41
" 4.....	" 23.....	5.35	5.35
" 5 Sunday.....	" 30.....	5.25	5.25
" 6.....	June 6.....	5.17	5.17

Monthly averages

1919			1920			1921		
Jan.	7.44	9.58	5.80	July	7.78	8.18	....	....
Feb.	6.71	9.15	5.34	Aug.	7.81	8.31	....	....
Mar.	6.53	8.93	5.19	Sept.	7.57	7.84	....	....
Apr.	6.49	8.76	5.33	Oct.	7.82	7.50	....	....
May	6.43	8.07	5.37	Nov.	8.12	6.78	....	....
June	6.91	7.92	....	Dec.	8.69	6.03	....	....

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, according to quantity. Prices, in dollars per flask of 75 pounds.

Date	1919	1920	1921
May 10.....	50.00	50.00	50.00
" 17.....	50.00	50.00	50.00

Monthly averages

1919			1920			1921		
Jan.	103.75	89.00	50.00	July	100.00	88.00	....	....
Feb.	90.00	81.00	48.75	Aug.	103.00	85.00	....	....
Mar.	72.80	87.00	45.88	Sept.	102.60	75.00	....	....
Apr.	73.12	100.00	46.00	Oct.	86.00	71.00	....	....
May	84.80	87.00	50.00	Nov.	78.00	56.00	....	....
June	94.40	85.00	....	Dec.	95.00	52.50	....	....

AIMS OF THE FOREIGN TRADE CONVENTION

The 'Final Declaration' of the Eighth National Foreign Trade Convention, held at Cleveland recently, emphasizes the following as necessary and desirable:

1. Increased imports into the United States.
2. The drawing upon surplus American investment funds in order to furnish long-term credits to foreign buyers.
3. Immediate creation of financial institutions under the Edge Law to extend such long-term credits.
4. Pending the revival of world commerce, the laying up of such of our Government owned Merchant Marine as cannot be chartered on a bareboat basis or on time charter to private operators.
5. Revision of our shipping laws, which subject American vessels to a competitive disadvantage estimated at 5% on the capital investment.
6. Uniformity of State laws affecting marine insurance companies.
7. Adequate international machinery for the enforcement of awards of commercial arbitration; and application of standardization to products not already so protected.
8. Adoption of revised and uniform commercial letters of credit and ocean bills of lading.
9. Maintenance of interest in American foreign trade, even though it shows no profit for the moment; and remembrance that in many cases it will cost much more to regain in the future a business lost now through lack of courage and foresight.
10. A bargaining tariff.
11. A reorganization of the foreign service of our Government, which will provide for unified control, and a permanent career to be started at a National Service Training Academy.
12. The passage of the China Trade Act, which will permit the formation of American companies to trade in China on a plane of tax equality with competitors of other nationalities.
13. The change in our taxation laws which will free Americans living abroad from paying taxes upon income derived from within the foreign country of residence.
14. Adequate support for those departments of the Government which participate in the development of our foreign trade.
15. The revision of our revenue laws necessary to permit the negotiation of a parcel-post Convention with Cuba.
16. The wider use of foreign trade news by our press.
17. The expansion of systems of international telegraphic communication under American control and operation.

A BILLION-DOLLAR CORPORATION

Standard Oil Co. of New Jersey made more money in 1920 than any other organization. Its net profit of \$164,461,409 was \$55,000,000 greater than the Steel Corporation and more than \$100,000,000 in excess of Standard Oil of Indiana, the second largest money maker of the Standard group. The New Jersey company does not give combined gross business. However, these can be estimated around \$1,500,000,000. Standard Oil of New Jersey, as at present constituted, is a great deal larger in earning power and assets than the entire old Standard Oil group, before it was disintegrated. For the first time the New Jersey company is admittedly a 'Billion-Dollar Corporation'—its assets are given at \$1,102,312,505.

MONEY AND EXCHANGE

Foreign quotations on June 7 are as follows:		
Sterling, dollars:	Cable	3.80
	Demand	3.81
Francs, cents:	Cable	8.12
	Demand	8.14
Lire, cents:	Demand	4.80
Marks, cents:		1.57

Eastern Metal Market

New York, June 1

With Decoration Day on Monday, the business community took a holiday of virtually three days from Friday night, which has accentuated the dullness prevailing in most of the markets.

Interest in copper has subsided, due to various causes; the fall in exchange is a prime factor in foreign sales.

Quietness prevails in the tin market with buying light and prices lower.

Demand for lead is small and there is some pressure to sell from some sources.

The zinc market shows no sign of improvement.

IRON AND STEEL

Buyers of iron and steel continue to act on the belief that lower prices are ahead, and the few current transactions that count at all give encouragement to that belief, says 'The Iron Age'. The old question of the attitude of the Steel Corporation toward concessions made by its competitors is up again in view of some recent transactions in plates, bars, wire, and wire nails. Though there are few products on which prices that went into effect on April 13 are strictly observed, the variations in wire are particularly a matter of comment. The view that price-cutting cannot be effective in a time of low-ebb demand is still held by some important producers; at the same time the Steel Corporation and such independents as have held to the schedule are not expected to 'hold the umbrella' indefinitely.

The railroads are still tightening up as buyers and at the same time intimating that they would buy steel at lower prices. The steel trade is not now so much concerned about lower freights preceding lower steel prices, since it sees both impending.

While the Steel Corporation's schedule this week amounts to 38% operation, independent companies are about 25%. New business is coming to the Steel Corporation's books at a rate below 20% of capacity.

Iron and steel exports in April, at 162,000 tons, were only 40% of the monthly average for 1920, being the smallest month's total in seven years. From the January peak of 647,000 tons the descent seems precipitous, but the January figures represented in part shipments of late 1920 of which statistics had been carried over.

COPPER

A decided lull is in evidence following the confidence which recently pervaded the copper market. This is particularly true of foreign buying which has been the mainstay in recent weeks. Domestic demand is even lighter than at any time lately—if this were possible. The slump in export sales is due largely to the sharp fall in exchange ratios which took place last week. The holiday recess here from Friday to yesterday has been a factor, especially in domestic selling. Prices rule fairly firm at 13.25c., New York, or 13.50c., delivered, for electrolytic for early or June delivery, with Lake copper about on the same levels. It is possible these values could be shaded from some sellers, but there has been no real test. As soon as European conditions settle a little and the holiday spirit has vanished, a better market is expected.

TIN

The feature of the market, if it may be so termed, is the limited number of sellers and their indifference to making sales. The market has consequently been quiet despite a general decline in London. This attitude by sellers has, however, kept the market steady here. Last Friday, the

last day of any recent sales, there were several 25-ton lots of May-June shipment Straits tin sold at 31.75c. and also 50 to 60 tons of spot Straits at 31.87½ to 32.50c., New York. There were also a few sales a day or so earlier at 32.25c., New York. On Friday there was a sharp drop in London, prices falling about £3 per ton; exchange also fell on that day. Yesterday London values were about £7 per ton below those prevailing a week ago, spot standard being quoted at £174, future standard at £175 and spot Straits at £178 per ton. Yesterday in this market spot Straits was quoted at 31.50c. Arrivals thus far in May are reported as 1355 tons with 2380 tons reported afloat.

LEAD

The market is very quiet and slow. The leading interest continues to quote 5c., New York and St. Louis, but in the outside market there is some pressure to sell, particularly at St. Louis, where the metal is offered at 4.70c. for early delivery, the New York quotation being 5c. These offerings are largely speculative accumulations.

ZINC

The market remains lifeless with no signs of improvement. Business is spasmodic and confined to small lots for immediate needs. Some producers continue out of the market at present quotations. Present needs are being satisfied at prevailing quotations which for prime Western are 4.75c., St. Louis, or 5.25c., New York. These could perhaps be shaded to 4.70 or 4.72½c., St. Louis, in some cases and under some conditions, it is conceded.

ANTIMONY

Wholesale lots for early delivery are quoted unchanged at 5.25c., New York, duty paid.

ALUMINUM

The leading producers quote virgin metal, 98 to 99% pure, at 28c. f.o.b. plant in wholesale lots for early delivery, while the same grade of metal, of foreign origin, is quoted at 22.50 to 23c., New York.

ORES

Tungsten: No business is reported and this market is marking time. Quotations are nominal at \$3.25 per unit for Chinese ores with Bolivian and other high-grade ores at \$4 per unit or higher.

Ferro-tungsten is quoted at 48 to 58c. per pound of tungsten contained in lump form, guaranteed quality.

Molybdenum: Quotations are nominal in an inactive market at 50c. per pound of MoS₂ in 85% or regular concentrate.

Manganese: There is no demand and stocks are piling up with imports at over 60,000 tons per month in the last 10 months. Quotations are nominal at 22.50c. per unit, seaboard.

Manganese-iron Alloys: There is almost no demand for ferro-manganese or spiegeleisen and quotations are unchanged. American ferro-manganese is quoted at \$80, delivered, and the British at \$75, seaboard. It is possible these prices could be shaded, though re-sale has sold at \$78, f.o.b. seller's plant. Spiegeleisen is inactive at \$30 to \$32 per ton, furnace.

Ferro-silicon, 50%, is quoted at \$80, delivered, with but little demand.

Ferro-vanadium is quoted at \$5 per pound of contained vanadium.

Ferro-chromium can be bought at the regular quotations of 16 to 16.50c. per pound of contained chromium in alloy of 60 to 70% and 6 to 8% carbon.



T. A. RICKARD, - - - Editor

COPPER SALES in May were the best for any month of this year, the total amount sold being 110 million pounds of metal. Export trade was double the domestic. Most of the buying came from Germany and Japan, with France ranking next.

THROUGH the 'Financial Times', of London, we learn that Mr. Simon Guggenheim, in an interview published by the 'Agence Economique', of Paris, stated that "with complete confidence it can be said that the price of copper has touched its minimum, and that there is every chance in favor of a recovery". This seems to us to be a safe prediction.

ECONOMIC conditions have been reviewed recently by Mr. Hoover, as Secretary of Commerce, in his usual straightforward way and with his usual sane optimism. Conditions are unpleasant, but they might be much worse; they are the logical consequence of causes plainly recognizable. He is confident that "we have fundamentally turned the corner". The last link in the chain of readjustment is the retailer, and it is he that is delaying a return to normal economic conditions and the completion of readjustment "all along the line". For example, we are informed that the beef that fetches, on the hoof, 8 cents per pound is sold by the packers at 16 to 20 cents; thus the packers seem to be profiteering, but obviously not to the same extent as the retailer, who sells the same beef at 40 to 45 cents. Pork that fetches 10 cents in the first instance is distributed by the packers at 23 cents and retailed at 60 cents. If pork chops are ordered in a Pullman diner one pays at the rate of \$1.80 per pound. Sometimes we regret that the Food Administration was dissolved so soon.

ANGLO-AMERICAN amity will suffer as a result of the frank utterances of Rear-Admiral Sims at London banquets and luncheons. His reiterated appreciation of so-called liberty in England—a liberty arising from the fact that the liquor traffic is practically immune from restrictive legislation—is unfortunate when taken in conjunction with other after-dinner indiscretions of speech. Complete liberty in any country is as dangerous as absolute self-determination. The Admiral has been fêted royally; his views on the drink traffic may be harmless as far as his immediate audiences are concerned; but if he should carry his interest in British

social life to the slums of London or Glasgow he would realize that he was treading on dangerous ground, and was incurring a responsibility that ill befits a citizen of a country whose mental, physical, and material vigor is due largely to sobriety. If the Admiral is really so much at variance with the social laws in force in the United States we are inclined to regret his recall by the Secretary of the Navy. We like the stand taken by the American Legion, which has issued a general order to its members, urging them to refrain from engaging in agitation for recognition of the Irish republic. This order was the last official act of Commander W. F. Galbraith, who, most unfortunately, was killed a few days ago in an automobile accident. In part he said: "The national commander is of the opinion that the problem involved is one which pertains to the people of Great Britain and Ireland, and can only be solved by them; that it is not a matter in which the American Legion is concerned, and that members, official posts, and departments of the Legion, as such, should refrain from participating in this agitation, directly or indirectly". Copies of this order should be sent to Admiral Sims, Senator Phelan, and W. R. Hearst. It is inadvisable, if not worse, to permit our national solidarity to be disintegrated by a controversy over a non-American question.

IT has been said of our friends, the British, that they never know when they are beaten. A few years ago Great Britain emerged from the War with a crushing load of debt on her shoulders; but, with the aid of the national attribute of "muddling through" with bulldog tenacity of purpose, the financial situation across the water is showing a slow but steady improvement. This news is of considerable significance to us; for the Atlantic is the most important of our trade-routes, and a condition of chronic financial sickness in Great Britain would soon be reflected in our own industrial life. In introducing the budget recently in the House of Commons, Mr. Austin Chamberlain stated that the sole remaining debt of Great Britain, other than what was owed to the United States and to Canada, was to Sweden, for £826,000, which was not paid because it was not yet due. He stated that foreign debt is the worst encumbrance that any country can be afflicted with. It is a drain upon the national resources; it reduces the purchasing power of the national currency; and it affects world credit. Half of the Anglo-French loan from the United States has

been paid off by Great Britain, at a cost of £51,370,000. Mr. Chamberlain added: this amount, together with other repayments, has reduced, during twelve months, the total debt owing to the United States by nearly £75,000,000. During the two years since April 1919 the external debts of Great Britain have been reduced by no less than £203,000,000. These facts are indicative that John Bull is facing the music with his customary determination; the British government's efforts at financial reconstruction will help to restore stability, not only in Great Britain, but throughout the world.

WORKERS in industrial plants are often thought to be suffering from metallic poisoning, whereas, as a matter of fact, the indisposition arises from another cause altogether. At a recent meeting of one of the branches of the Society of Chemical Industry, Mr. Stephen Miall emphasized the fact that constant exposure to any chemical compound is likely to be injurious to health, especially if dust, fume, or gas is given off; an abundant supply of fresh air is the best provision against illness on the part of the worker. The susceptibility of many persons to the smell of freshly applied paint is well known, and suspicion has been fastened, though insecurely, on the white lead, the oil, and the 'dryers' of which it is composed. It is now considered almost impossible that volatile lead compounds are given off; Mr. Miall explains that the turpentine is the delinquent; kidney disease is caused, and the patient is predisposed to gout. Copper, tin, nickel, and manganese are said to have properties that are injurious to health; but cases of poisoning in the industrial plants that produce or fabricate these metals are few and far between. Lead poisoning in England at one time reached serious proportions; at present, thanks to wise and efficient preventive measures, the number of cases has declined until it is now less than one-tenth of what it was twenty years ago. It can be taken as axiomatic, says another authority, that lead poisoning is caused by the inhalation of dust or fume; in the absence of either there will be no poisoning; efficient ventilation is the essential. Investigations have shown that the minute particles of lead compounds, which may float in the air, reach the lungs of the workers, where they are acted upon by the juices of the body, and so enter the circulatory system. The prevention of dust, or its removal at the moment of formation, the deflection of vapors or volatile solvents, and the substitution of fresh air will, in the opinion of Mr. Miall, reduce the number of cases of painters' colic to insignificant proportions; no other remedy will be as efficacious.

Mexican Affairs

It is much to be regretted that the exchange of views between Washington and Mexico City has not concluded, as had been expected, in the recognition of President Obregon's government by that of the United States. The failure to accord this consideration to the government now established in Mexico is unfortunate because it

renders President Obregon's position more difficult at a time when he deserves the moral support of the United States. The legislatures of several of our States, notably California, Arizona, and Oklahoma, have passed resolutions urging an early recognition of the Obregon government; this action will impress most of our readers more than the fact that several European governments have already done what our own Government has been advised to do. Just now the consummation of mutual goodwill is halted by President Obregon's unwillingness to accept 'recognition' with any 'condition'. On the other hand, Mr. Hughes, as Secretary of State, asks a guarantee that our nationals shall be protected in life and property, and more particularly from such acts of spoliation and confiscation as marked the régime of Carranza. Those who are interested in mining affairs in Mexico will appreciate the need for the stand taken by Mr. Hughes and will be grateful to him for it, while wishing intensely that the diplomatic exchanges may be concluded amicably and with good result. Incidentally, it appears that President Obregon's unwillingness to accept any 'condition' is due in part to the reckless and inaccurate telegram issued by the Associated Press on May 23, in which it was reported that our State Department was about to impose sundry drastic changes in the Mexican constitution as a pre-requisite to 'recognition'. This must have hindered seriously the effort to arrange matters in a friendly way. The gentlemen south of the Rio Grande have national pride like the rest of us and resent not unnaturally any trespass upon their self-respect. Mr. Hughes has not made the mistake, as some of his predecessors in office did, of saying how the Mexicans shall govern themselves or of assuming that our form of government is the one best suited to the Mexican people; he is conducting the negotiations with courtesy as well as fairness, and we hope that a way out of the difficulty will be found. It is greatly to the interest of both the Mexican and the American peoples that they should live in harmony and do business with each other amicably.

Revision of the Mining Law

On pages 865 to 869 of this issue we publish the text of the proposed new mining law, sent to us by Mr. H. Foster Bain, the Director of the U. S. Bureau of Mines, to whom it had been transmitted by the committee appointed by the former director, Mr. Van H. Manning, on the initiative of the Mining and Metallurgical Society of America. This draft of a new law, and the revision of the old law that it embodies, is the result of the discussion started by the Mining and Metallurgical Society eight years ago. Mr. H. V. Winchell took a leading part in guiding this discussion, being moved thereto partly by his general knowledge of apex litigation and partly by his own personal experience in Alaska, where he suffered what he, and most of us, considered to be an injustice in consequence of the unfair incidence of the existing law. In 1914 the Society issued a questionnaire on the subject and elicited the views and votes of a number of repre-

sentative metal-mining organizations in the United States. In 1915 a special meeting of the Society was held at Washington; to this were invited the representatives of many organizations, to whose attention the subject had been brought by means of the questionnaire of the previous year. At the meeting it became evident that there was a strong sentiment in favor of the revision of the law, especially in respect of the extra-lateral right and the requirement of discovery before location. Mr. W. R. Ingalls, who was then president of the Society, took a leading part in these proceedings. An effort was made to induce Congress to appoint a commission to take testimony on the subject, but members of Congress suggested that those engaged in mining, more particularly the engineers, should submit their views, to which prompt and definite consideration would be accorded. The Mining and Metallurgical Society, which, by the way, consists of a small and select number of engineers and geologists, most of whom are also members of the American Institute of Mining and Metallurgical Engineers, was unwilling to undertake the task, recognizing the need, *inter alia*, of legal advice in formulating any legislative enactment. Moreover there had been a feeling at Washington that some of the engineers represented private interests, and the knowledge that such an idea existed was enough to make them "loath to devote further time to the subject unless sponsored by some individual or organization which was above possible suspicion of an ulterior motive". We quote from Bulletin 140 of the Mining and Metallurgical Society. An *impasse* seemed imminent when Mr. Ingalls and Mr. Manning conferred with a view to preventing a failure of so much well-meant effort, and it was arranged that the Bureau of Mines should appoint an advisory committee to be nominated by the Society, "and furnish the legal talent necessary from its own staff". Thereupon, on January 23, 1917, Mr. Ingalls was appointed chairman of this committee, with Mr. Walter Douglas as vice-chairman. The other members were Messrs. J. Parke Channing, J. R. Finlay, John Hays Hammond, Hennen Jennings, and L. D. Ricketts. Mr. Winchell could not serve because he was about to go to China; but on the decease of Mr. Jennings, in March 1920, he joined the committee. Mr. J. R. Jones, law examiner for the Bureau, was appointed secretary and legal adviser. Later he was succeeded by Mr. Paul S. Black as solicitor of the Bureau. During the War not much could be done; but, since the Armistice, Messrs. Jones and Black have studied the discussions, the results of the referendum, and the questionnaire, and have prepared a draft, which "harmonizes the majority of views as expressed during the past few years with such parts of the existing code as appears most desirable to retain". Again we quote from the Society's bulletin. This draft was submitted to the committee and is now in the hands of the House and Senate Committees on Mines and Mining, the chairman of these co-operating in making such further changes as may be found desirable after discussion in Congress.

In our last issue, under 'Review of Mining', we quoted

at length from the report presented by Mr. Ingalls, as chairman of the Committee on Revision, to the Director of the Bureau. In that report Mr. Ingalls gives an admirable summary of the proposed law, and our readers will find that summary useful in giving them both an outline and an explanation of the proposed Act. It will be noted that whereas the principle of extra-lateral right is abolished, the requirement of discovery is retained in a modified form as a condition precedent to the obtaining of a patent on a mining claim. The area covered by a location is to be nearly double that staked under the existing law. The lines of all claims must conform to the subdivisions of the General Land Survey and are oriented with reference to the cardinal points of the compass, instead of being irregular as at present and making intersections, overlappings, and complexities. It may seem that rigid compliance with this regulation will be impracticable in a new region; even if every prospector be supposed to carry a compass, he may not know the magnetic variation in the locality of his claims. The requirements of assessment work are changed, so that a payment of \$5 per acre may be paid directly in the nearest Land Office in lieu of work done on the claim; and this money is to be set aside as a special fund to be used for the purpose of "developing the mineral resources" of the mining district in which it is collected. The spending of the money is left to the Secretary of the Interior. In order to provide space for the storage of tailings, and other material now discarded but likely to prove of economic value in the future, by reason of improvements in metallurgy, it is specified in the Bill that adequate areas of public land shall be purchasable for this purpose. Evidently the whole matter has been considered carefully and by men who have given much thought of it. We find some of the wording awkward and some of it obscure, but these defects will be remedied by the legislative committees. Meanwhile we shall be glad to hear from our readers; it is highly desirable that public opinion be expressed on both the matter and the manner of the proposed law, which necessarily will play an important part in the further development of our mining industry.

Simplicity in Metallurgical Planning

Complication in the planning of metallurgical processes should be avoided at all costs. An expert consultant, with a wealth of ideas, may design the plant; but the man who has the task of operating it is provided usually only with a brain of normal size and character; he is helped by assistants and laborers, each of whom has only two hands and two feet; the majority of operators are accustomed to practice, but they usually balk at theory. If the designer had to operate the plant he would, in many cases, make a greater effort, during the preliminary planning, to avoid complications; simplicity should be the primary aim of every constructional engineer, for by it accuracy is made more nearly obtainable. The unnecessary is avoided. These comments are made

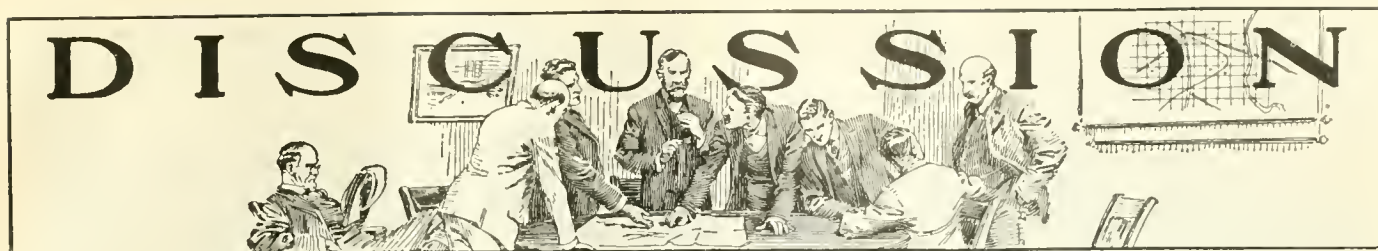
as we all to mind the fate of an enterprise that depended for its financial success on an elaborate scheme that was to be put in practice in a foreign country, and far from home. Under such conditions it should be realized that simplicity is all the more desirable: repair parts often are difficult to obtain, and skilled labor usually is scarce. The equipment was exceptionally complete; everything that money could buy was requisitioned by the consulting engineer. The plans and reports were so complicated with figures and charts that, although additional professional advice of a most expensive kind was obtained before the final acceptance of the scheme, the unfortunate sequel was never anticipated. The plant was erected. A section was made to operate with comparative ease, but the engineer in charge of the operation of the plant had no faith whatever in the scheme of treatment, and he said so. So far as human endeavor could go, he and his assistants worked to achieve satisfactory results, but all their efforts were in vain. At length, after an emphatic statement of the facts had been forwarded to the head office of the company, the governing officials of the enterprise decided that the designer of the plant should be given an opportunity to prove the process. This was done, and he was provided with as many assistants as he needed. The plant was re-modeled and re-arranged, at considerable expense, but it still remained hopelessly complicated. The engineer's assistants were loyal and hard-working; after a few months, all concerned became physical wrecks, but a measure of success was obtained—a portion of the material was treated with good results; the remainder, however, refused to dissociate itself in the proportions and in the directions that were anticipated in the flow-sheets. After some months of useless and profitless expenditure it was realized that the scheme, as viewed from the economic aspect, was a complete failure; with expert help and at considerable cost it could only be made to show a small measure of technical success. The plant was at last closed down; the machinery was sold for what it would fetch; the money that should have been used for furthering research work of a promising nature had been wasted. In some respects the operation had been successful, but the patient died. The treatment involved too many complications.

The Japanese Problem

Herbert Spencer's opinions with regard to the possible admixture of the Eastern and Western races were used with telling effect by Senator James D. Phelan, of California, in a speech made before the Senate recently. It appears that when Japan organized her government she asked Spencer, who was considered one of the greatest economists of his time and an accepted authority on such subjects, whether foreigners should be admitted. "Emphatically, No," was the reply. Spencer then wrote a letter to the statesmen of Japan, stipulating that it should not be published until after his death; and in it he advised the Japanese to grant to foreigners only bare commercial privileges, to forbid them to own lands, to

hold them at arm's length, and to make no attempt at intermarriage, because, he averred, it is impossible biologically under such circumstances to produce a race that will not be of a deteriorated type. He instanced the half-castes, the mestizos, the mulattos, and the mongrels of other countries. In most cases, nationals of different types, each good within his limitations, have been ruined by the attempt at amalgamation. Thus it is impossible to consider the Japanese as coming to our country for the purpose of assimilation; and they know it. They themselves have refused to foreigners all the privileges they ask of us; they have granted them, as they were advised by Herbert Spencer, only bare commercial privileges; and this has been to their great advantage, for they have preserved the purity of their race. In the arts and in manufactures they are successful, and as a fighting people they rank with the best.

Spencer entirely approved the regulations that were established in the United States for restricting Chinese immigration, which was a much older problem than the one we have now with Japan. The Chinese were excluded in 1879; the Japanese did not begin to arrive until about 1885; and then they came by way of Hawaii; they were permitted to settle where the Chinese had been barred. Writing on the subject of Chinese immigration, Herbert Spencer showed that if these foreigners were allowed to settle extensively in the United States, a bad hybrid would result, or they would remain unmixed. In either case, supposing the immigration to be large, immense social mischief would result, leading to disorganization. The Japanese in the United States remain unassimilated. Japan followed Spencer's advice to the letter; and, as Senator Phelan says, when we bar the Japanese from the land, when we restrict Oriental immigration, we are acting exactly as Japan herself is acting: it indicates a policy that has been successful in Japan during the past half-century; she will not admit Koreans nor Chinese when either competes with her own people; and she is wise. We too want no settlers in this country who cannot be assimilated, and assimilated readily into the great American family; and this is the fundamental reason why California does, and why the United States as a whole should, object to Japanese immigration. The test of the entire desirability of any type of immigrant is that the alien, on examination, and after a residence of a few months or a few years, as the case may be, can be considered, by an impartial tribunal that knows nothing as to his country of origin, as an American—first, last, and all the time—in speech, habits, and in his community life. There are degrees of fitness for citizenship, but ability to assimilate quickly and to become a typical American is the primary essential. If the immigrant retains a too fervid adherence to the people or the customs of the land of his birth, and shows it, he will not make an ideal citizen; if his children are encouraged to speak a foreign language, if they are taught to preserve an alliance to foreign ideals and to foreign traditions, then he and his type are undesirable, for assimilation is impossible.



Gold in Black Sand

The Editor:

Sir—Probably a treatment suitable to one locality would be unsatisfactory when applied in another. The richness of black sand is as variable as its components. In working vein-ore the results from the mill and from the concentrates are not a constant, and the richness of black sand differs materially even in a few feet. I have carried out a number of perhaps rather crude experiments, but believe the results may be useful to some of your readers. I have concentrated down to the nearly clean black sand, and I found much less gold in it than when a considerable proportion of the heavy gray and brown sand was left in. After amalgamation, I separated the concentrate magnetically—the non-magnetic averaging 35 to 40% of the original. By grinding the magnetic, I find it releases about 10% more of the non-magnetic—by various tests, which need not be specified. I obtained practically no value out of the magnetic material. By roasting the non-magnetic portion to cherry red and then grinding it, I get values in gold ranging from roughly \$50 to \$800 per ton that can be amalgamated. Grinding alone without roasting gives a good return, but roasting increases it. I find that by grinding a sample without magnetic separation, extraction is considerably reduced, and is reduced by about 80% if the non-separated sample is roasted. I speak, of course, of recovery by amalgamation. As about 20 lb. of this non-magnetic sand can be recovered here per cubic yard of gravel it is an important asset. My conclusion is that every large placer proposition 'contaminated' with black sand, should have a concentrator, an electro-magnetic separator, and a ball-mill as part of its plant, and where platinum is present, a complete chemical outfit may also be necessary.

J. S. TAYLOR.

Rogue River, Oregon, May 24.

The Strike at Tonopah

The Editor:

Sir—In your issue of May 28 is an article regarding conditions in Tonopah. Whoever gave you this information has garbled the truth to such an extent that we thought possibly the real conditions might receive your attention also. It is true that 25 to 30% of the number of men employed before the walkout are still working, but their wages were not cut. They are working at the old scale. Not one has gone back to the mines where wages were reduced. The operators have brought in quite a

number of boys and men on several occasions, and nearly all of the first two bunches deserted upon arrival here. The others are of no value as mine or mill-workers.

The rails of the T. & G. Ry. Co. were greased by someone and the miners are making a thorough investigation to find out who is guilty. The street talk is to the effect that the operators caused it to be done in order to create an unfavorable impression in the public mind. They have been unable to incite the men to violation of the law so far. The big gambling houses are closed and there is no drunkenness or disturbance of any kind, owing to the fact that we have a level-headed sheriff who tends to his business and takes orders neither from the men nor the operators.

If the operators made the wage-cut with such arbitrary suddenness in retaliation of some fancied violation of an agreement, they have repented of their act at leisure and will continue to do so; however, they have seen a great light and the chances are that the camp will soon be going again in peace and prosperity, and we feel that they will not soon forget the lesson they needed.

I trust you will be as liberal in publishing the version of those who really produce the gold and silver in Tonopah as you have been to those who furnished the misinformation published.

HARRY BUTSON,
Chairman Mine and Mill
Workers Committee.

Book-Reviewing

The Editor:

Sir—The criticisms called forth by A. W. Allen's reviews on Slosson's 'Creative Chemistry' and Soddy's 'Science and Life' are not without interest, though I do not agree with either critic. P. B. McDonald's view that, because a book is a prodigious work and on the whole is sound, only its praises should be sung and its minor flaws should be overlooked by the reviewer is, to my way of thinking, untenable; nor do I believe such leniency would be appreciated by the author. Herbert Spencer complained of what the critics left unsaid, rather than what they said about his books. To spend years of toil—pleasant toil, perhaps, but nevertheless toil—on a book, and then to have it reviewed only in the barest outline, with a pean of praise added, surely would be far more disheartening than to have it intelligently, even if ruthlessly, reviewed; and evidently Spencer so thought, for in his autobiography he reviews several of his own books at considerable length; and, having built the structures and knowing their weak points, he did not fail to

indicate their weaknesses for the purpose of showing how reviewers might have made constructive criticism. H. G. Wells too, in his 'Outline of History', evidently appreciates the criticisms of his collaborators, for a bombardment of such, in the form of footnotes, accompanies the text. Only by such constructive criticism can perfection in future editions be approached.

Turning to the Austin criticism of the review of 'Science and Life', and comparing it carefully with the review itself, I fail to see that Mr. Allen can be accused of undertaking "to strike at religion over the Professor's [Soddy] shoulder". He entirely fails to make the point. I take issue with Professor Austin, too, when he says: "I can assure Mr. Allen that a generation ago when Darwin's views on evolution were pressed to the limit, scientific men were cocksure they were right". If there were any cocksureness about the controversy at that time it did not come from the scientists. Huxley, as soon as he had read the 'Origin of Species', constituted himself as the champion of Darwin's views, and never tired of reiterating his opinion that he considered it to be the best working hypothesis that had been offered; but seldom did he fail to point to what he believed to be one great weakness of the theory: the infertility of hybrids. This he believed some day might be elucidated. Scientists of a generation ago did not consider Darwin's theory a finality, nor do scientists today; but, like those of a generation ago, scientists of today consider it the best working hypothesis that has been offered; and a good many theologians have come around to the same way of thinking. That Huxley considered belief in evolution to be comparable with belief in a God—not necessarily the God of Abraham, of Isaac, and of Jacob, but of a God—is evident, for he was too great a hater of humbug to have chosen the following lines (from one of his wife's poems) to be engraved on his tombstone, had he not believed in a deity:

"Be not afraid, ye waiting hearts that weep,
For still He giveth his beloved sleep;
And if an endless sleep He wills, so best."

Victoria, B. C., June 2.

F. H. MASON.

Moonshine Power

The Editor:

Sir—In the 'Press' of May 21, bottom of page 702, you state, "the earth underneath the water being subject to a less attraction because of greater distance".

Therefore take a deep mine shaft with a strong head-frame and sheaves with proper ropes suspend two boxes one above the surface, the other at a suitable depth in the shaft. Fill the boxes with suitable weights until they balance each other, then add enough additional weight until the upper box will just lift the one in the shaft. Now when the moon comes to the zenith it will attract the box on the surface, the shaft box not being subject to this attraction will sink causing a rotation of the sheave-wheels.

According to your article the moon lifts the water

1.34 ft., which would mean it lifts about 80 lb. per square foot, unless the tensile strength of water 52 grammes per square centimetre causes the lift of 1.34 to be less than with no tensile strength to water, the surface box need not weigh over 80 lb. to the square foot; the shaft box can be of any shape.

Leaving out the sun, then about twice a day the surface box will rise causing the sheave wheels to rotate; attach a dynamo to sheave wheels and you will have moonshine! The power produced will, of course, be: lift in feet \times 50 \times area of box in square feet, minus friction, divided by half of 1419, which will give the effective foot-pounds per minute.

I have not as yet calculated how high the box will lift but any astronomer can work it out.

Philadelphia, May 27.

R. H. SANDERS.

[Had our correspondent read the editorial in question a little more carefully he would have seen that the tidal rise of 1.34 ft., due to lunar attraction, was the result of an observation made in the centre of the Pacific area, where there would be difficulties in the way of obtaining a foundation for the apparatus described. Our correspondent does not appear to have selected a suitable avenue for research.—EDITOR.]

Russian Placer Mining

The Editor:

Sir—In your issue of April 30 I was pleased to read a letter from G. L. Holmes in criticism of Mr. Perret's article that you had recently published. Mr. Holmes is correct in maintaining that the electric-dredge possesses superior qualities to a steam-dredge, as I will show later by figures of actual results obtained at Kolehau. Mr. Perret is hopelessly wrong in most of his references to Kolehau; in the first place, there are not two electric-dredges, but one steam-dredge and one electric-dredge, and the power-station does not consume 10,000 to 15,000 cu. sag. per season: 1250 cu. sag. being about the average figure.

During two consecutive seasons, the results of the two dredges of the Orsk Goldfields company as regards fuel consumption and yardage were as follows:

	Cu. sag. wood consumed	Cu. yd. dredged	Cu. sag. wood consumed	Cu. yd. dredged
Electric	1291	730,515	1268	788,306
Steam	1263	137,773	906	105,080

Though the steam-dredge has much smaller buckets and operates under rather more difficult conditions, those disadvantages cannot account for the fact that the electric-dredge accomplished more than five times the yardage per unit of fuel consumed than the steam-dredge does. Your correspondent, Mr. Holmes, will no doubt be amused at the way Mr. Perret's arguments collapse when the truth becomes known. It is to be hoped that the rest of Mr. Perret's article contains no other misleading statements, like some of those he has made concerning Orsk Goldfields.

S. J. SPEAK.

London, May 20.



THE MINE AT CHUQUICAMATA

The Chuquicamata Enterprise—II

By A. W. Allen

To speak of the moving of a mountain is to be reminded of the school-boy's definition of faith as "the quality that enables you to believe what you know to be untrue". Faith in the ultimate success of the work at Chuquicamata, where a mountain is being moved without fuss, was, necessarily, an important asset; but the application of science, by men of courage, skill, and experience, was the dominant factor that ensured the fruition of plans on an ambitious scale.

Few more striking examples of the natural blending of colors can be seen than at Chuquicamata. From across the gully a panorama of broken and exposed rock meets the eye. At the time of my visit, some extensive showings of bluestone gave an intense coloration to sections of the faces; in the distance there blended the green of the brochantite and the atacamite with the blue of the chalcantite—all mixed with yellow and reddish iron stains. In addition to brochantite ($\text{CuSO}_4 \cdot 3\text{Cu}(\text{OH})_2$), atacamite ($\text{Cu}_2(\text{OH})_3\text{O}_3$), and chalcantite ($\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$), there are a number of rarer minerals in the deposit; these include krönite ($\text{CuSO}_4 \cdot \text{Na}_2\text{SO}_4 \cdot 2\text{H}_2\text{O}$), an azure-blue mineral, and coquimbite ($\text{Fe}_2(\text{SO}_4)_3 \cdot 9\text{H}_2\text{O}$), a soluble mineral occurring in a number of colors that vary from white to green. Other unusual minerals are blödite ($\text{MgSO}_4 \cdot \text{Na}_2\text{SO}_4 \cdot 4\text{H}_2\text{O}$), colorless to brick red; fibro-ferrite ($3\text{Fe}_2\text{O}_3 \cdot 2\text{SO}_3 \cdot 10\text{H}_2\text{O}$), and copiapite ($2\text{Fe}_2\text{O}_3 \cdot 5\text{SO}_3 \cdot 18\text{H}_2\text{O}$), two types of yellow minerals that are found near Copiapo, from which the latter-mentioned one takes its name; mirabilite ($\text{Na}_2\text{SO}_4 \cdot 10\text{H}_2\text{O}$), melanterite ($\text{FeSO}_4 \cdot 7\text{H}_2\text{O}$), jarosite ($\text{K}_2\text{O} \cdot 3\text{Fe}_2\text{O}_3 \cdot 4\text{SO}_3 \cdot 6\text{H}_2\text{O}$), and alunite ($\text{K}_2\text{O} \cdot 3\text{Al}_2\text{O}_3 \cdot 4\text{SO}_3 \cdot 6\text{H}_2\text{O}$). In the sulphide zone the principal copper minerals are cupriferous pyrite (CuFeS_2) and enargite ($3\text{Cu}_2\text{S} \cdot \text{As}_2\text{S}_7$), together with chalcocite (Cu_2S) and covellite (CuS).

There is no sharp line of demarcation between the ox-

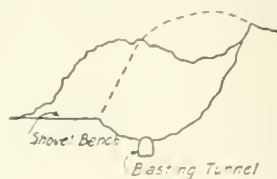
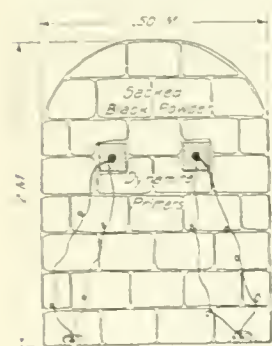
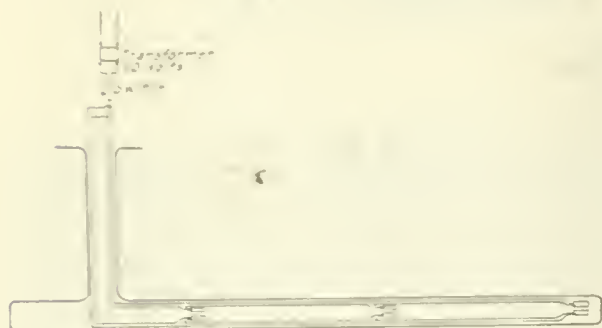
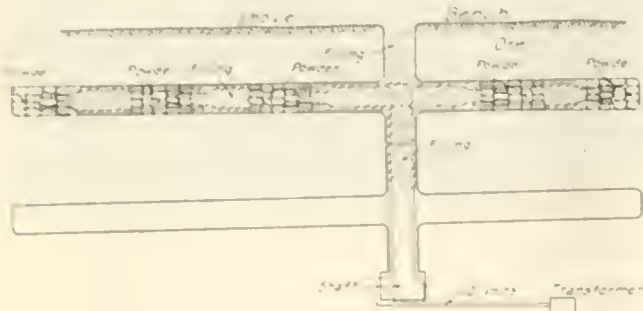
idized and the sulphide zones. The mixed zone at Chuquicamata is of considerable extent, the ore-reserves in this part of the mine amounting to over 150,000,000 tons of an average copper content of nearly 3%. No method of treating this mixed ore has been formulated as yet, nor is the question likely to be considered until an appreciable effect has been made on the immense tonnage of material that is now available and that contains easily soluble copper minerals. Water level occurs along a plane, which is independent of the existing topography, at a depth that varies from 270 to 800 ft. below the ground, the average being about 600 ft. Water level is usually in the mixed-ore, but occasionally in the oxidized-ore, zone; in only one case was it found to correspond with the line of demarcation between the two zones. A steady decrease in the amount of oxidized ore occurs at depth; chalcocite is met with first, then a mixture of chalcocite and primary sulphide, then primary sulphide only.

A small amount of the ore that is milled is broken by means of powder blasting with churn-drill holes, the greater proportion by far being obtained by the shattering of immense bodies of rock by the explosion of large amounts of powder in tunnels that are driven in lines parallel to the working face. Mining at Chuquicamata is an illustration of rock being broken on a vast scale, on a larger scale than in any other part of the world. The tunnel floor is driven at a level about three metres below the bench on which the steam- or electric-shovels operate, in order to be sure that loose rock is always in the path of the dipper. The height between benches is taken at 45 metres and the horizontal distance between blasting tunnel and face, 30 metres. Entrance to the tunnels is by means of shafts and cross-cuts. The distance between blasting-tunnels depends on the height of the orebody; for a height up to 75 ft. the tunnels are driven so that

the centre-to-centre measurement is 15 metres; for a height between 75 ft. and 100 ft. it is 22.5 metres; for a height over 100 ft. it is 30 metres. The tunnels are 2 metres high and 1.5 metres broad. The amount of powder used depends on the character of the rock in the immediate vicinity, the height of the orebody, and other varying features. Factors are used in connection with the work, with the result that a scientifically accurate

within a few feet the line at which the ore will extend after the explosion. Track moving is, therefore, considerably simplified. The disintegration of the mass is also more complete; shoveling costs are reduced; the bench is worked more easily because the ore does not hang at a dangerous angle. The increased cost of powder, when an adequate amount is used, is more than counterbalanced by decreased expense in handling the rock. Whatever the amount of explosive used, however, a proportion of large boulders results; these have to be broken down with Jackhammers and blasted separately. The original estimate of primary breaking at the plant was, as has been mentioned before, defective; larger machines had to be installed to handle the boulders.

The powder used in blasting is made locally, the composition being 75% Chilean nitrate, 15% charcoal, and 10% sulphur. The mixture is stacked in 100-lb. sacks in the tunnels, the amount used in any particular place depending on the factor already mentioned. Boxes of 40



BLASTING-DIAGRAMS

Method of loading tunnels (top); method of wiring tunnels (centre); arrangement of powder, dynamite, and leads (left-hand, bottom); effect of varying amounts of explosive (right-hand, bottom).

estimation can be made beforehand as to the results of any explosion.

It has been found that there is a limit to which economy in the use of powder can be carried. By reducing the quantity, the ground is merely broken, and remains, to a large extent, *in situ*; an adequate amount of explosive will cause a disintegration of the whole mass—the force of the explosion will throw it forward in the form of a billow. Thanks to the use of the factor already mentioned, and the intelligent control of operations in other directions, it is possible to anticipate to



THE RESULT OF A BLAST

or 60% dynamite are placed in the centre of the charge in amount equivalent to about 2% of the weight of the powder to be used. The tendency has been to reduce the distance between charges; a centre-to-centre measurement of 10 metres was customary in earlier operations; but the distance has now been reduced to 8 or even 6 metres. Electric exploders are used. One box of dynamite is arranged with a hole in the side for two leads, connecting with detonators and sticks of dynamite; the two (No. 7) exploders in each charge are connected with separate circuits. A circuit must not exceed over 3000 ft. in length; for four circuits a 2-kw. alternating-current single-phase transformer is necessary to reduce the voltage to 110; for a larger number of circuits a correspondingly larger transformer is used. All the exploders in the circuit are connected in series; a maximum of 18 exploders per circuit is maintained. The lead wires are of 14 gauge (B. & S.); these are laid in $\frac{1}{2}$ -in. grooves in a 2 by 4-in. stringer, which is then covered with a 1 by 4-in. strip. Against each side of the charge of powder in the tunnel a wall of sacks containing stones is built; the intervening space between the sacked-stone protecting

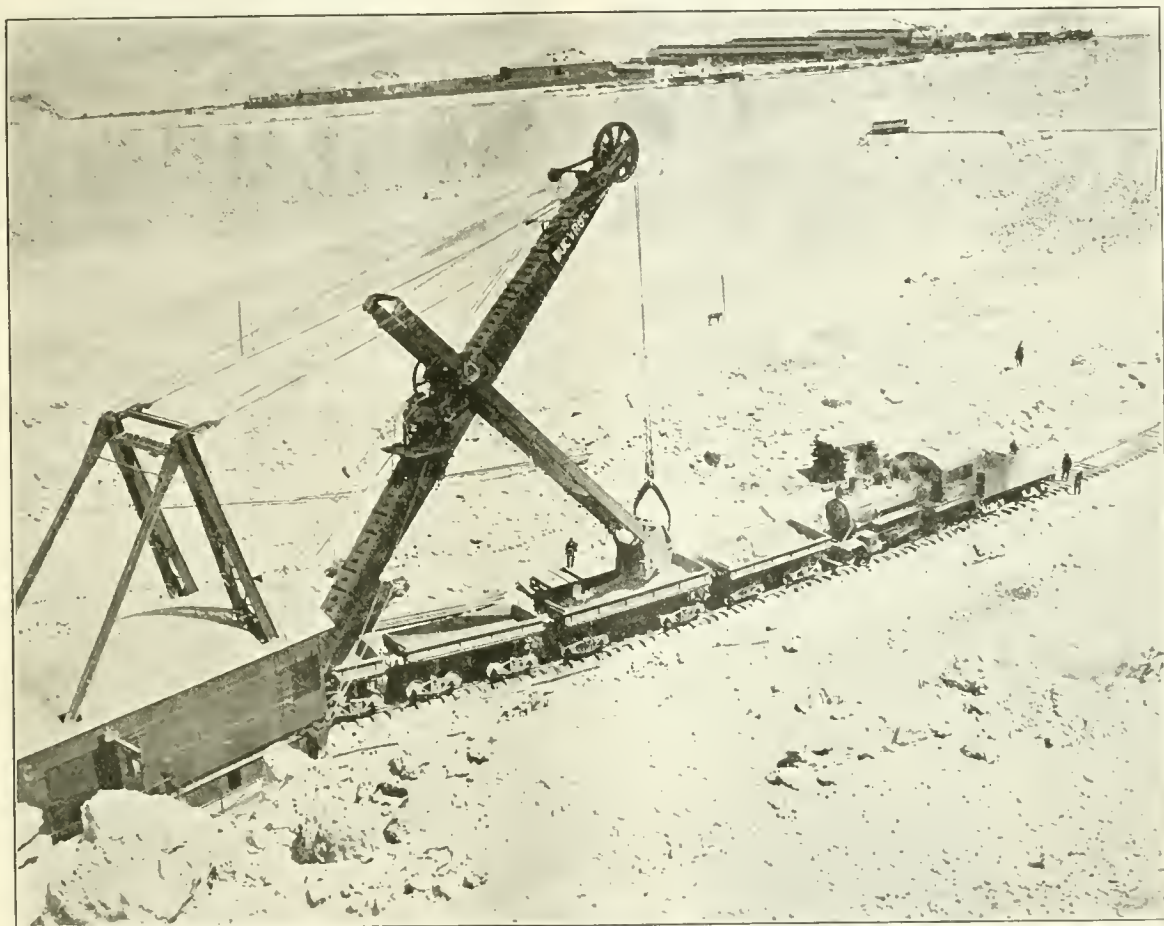
wall is filled with waste or ore.

Details of a comparatively recent charge (No. 42), by which the effect was achieved entirely by tunnel blasting, without the use of auxiliary drill-hole blasting, were as follows:

Length of tunnels, metres.....	204
Black powder used, lb.	363,500
Dynamite used (40%), lb.	5,850
Ore broken, tons	740,270

A considerable amount of research is being carried out with regard to the best method of firing. To date all charges have been fired simultaneously; but with added

accompanying halftone and line drawing; in the latter, the dotted line represents the angle of repose of the broken rock after a cushion shot; the heavy line, corresponding to the effect shown in the photograph, is the result that is obtained after the use of an adequate amount of explosive. Tunnel blasting has almost entirely superseded churn-drill blasting at Chuquicamata, the latter method only being used under special circumstances, and for small work. As may be imagined, there are no misfires in tunnel blasting, and this indicates an important item of superiority. The cost of breaking is also considerably less.



A 225-B BUCYRUS ELECTRIC SHOVEL AT CHUQUICAMATA

experience, aided by the study of motion pictures, the officials are of the opinion that quick-series blasting may be preferable. In this event the switch connecting the electric detonators with the source of current may be arranged somewhat after the construction of a rheostat, the various charges comprising the blast being fired in quick succession, almost simultaneously. By a mechanical operation of the switch, the time intervals between the explosion of individual and contiguous charges may be adjusted to a nicety, the result being in the nature of a *feu de joie* on an imposing scale. It seems probable that an economy in explosive may be effected by the adoption of such a scheme.

The advantages of the present method of blasting as compared with cushion shooting is well shewn in the

Removal of the broken ore from the bench is effected by means of electric- or steam-shovels of various kinds. The electric-shovel is preferred because of greater ease of manipulation, cleanliness, and lower operating cost; these factors more than counterbalance the increased first cost of the machine. The largest shovel on the property, a 225-B electric Bucyrus, is shown in the accompanying halftone, the photograph for which was taken from the bench above. The dipper is of 6-cu. yd. capacity.

The ore is transported to the mill in large cars, originally designed for bottom discharge; these are hauled by standard American locomotives. Ore and car weigh 90 tons; ore alone, 68 tons. The cars, on reaching the crusher-station, pass into a special type of tippie, which locks the car, elevates it about 30 ft., turns it completely

over and tips the contents on to one of two grizzlies, which precede two 84 by 60 in. jaw crushers, made by the Power & Mining Machinery Co. Each of these machines has a capacity of about 1200 tons per hour, crushing to

pletely the dust that is produced would result in a considerable amount of action on iron and steel.

The swinging jaw breakers are operated by a rope drive from electric motors. The crushed ore, together



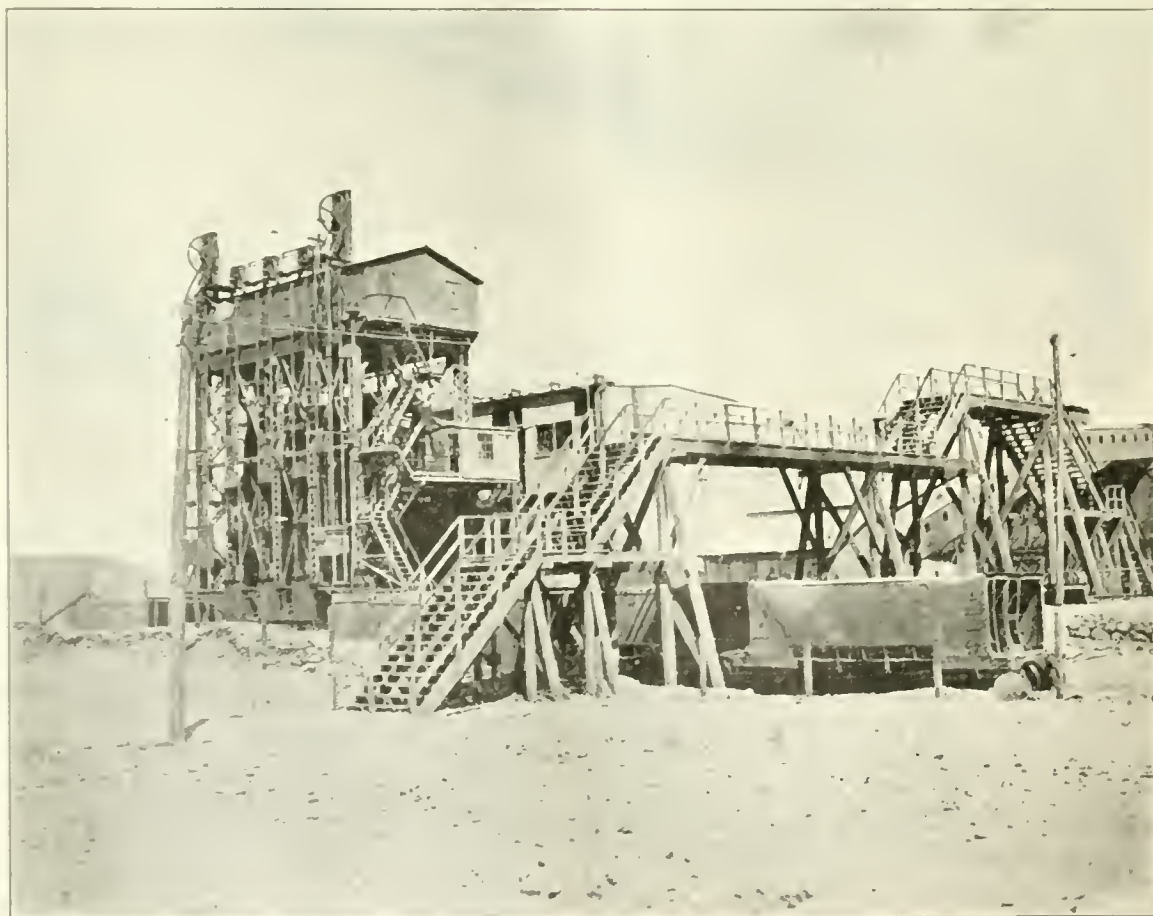
SMALLER ELECTRIC SHOVEL LOADING CARS



CAR TRAIN WITH STANDARD LOCOMOTIVE

about 10 in. Spraying to reduce dust is practised, a hose being used, as shown in the accompanying halftone; but the amount of water must be strictly limited. The copper minerals are so soluble and the resultant solution is so corrosive that the use of sufficient water to allay com-

with the undersize from the grizzlies, drops to a 48-in. belt-conveyor, on which it is conveyed to the primary ore-bin, which has a capacity of 13,000 tons. The discharge of the 48-in. belt-conveyor is distributed throughout the ore-bin by means of a 48-in. shuttle-conveyor.



CAR-TIPPLE AT THE CHUQUICAMATA PLANT

The crushed ore is drawn from the ore-bin by means of 16 pan-feeders delivering to three 36-in. belt-conveyors. Each belt-conveyor discharges over a grizzly, the over-size of which goes to a McCully crusher, where it is reduced from 10 in. to 3 in. The crushed and screened ore is delivered to three 36-in. belt-conveyors, over which three stationary mushroom magnets are hung, for the removal of tramp iron and steel. The ore again passes over a grizzly, after which it is fed to eight 48-in. horizontal-disc Symons crushers, which reduce it to $1\frac{1}{2}$ in. The final crushing is done in twenty-four 48-in. vertical-disc Symons crushers, the leaching product containing about 12% of material that will rest on a 0.371-in. screen. A typical analysis of the material that goes to the leaching vats is as follows:

Mesh	In.	%
On	0.371	12.6
" 8	0.093	56.5
" 100	0.0058	8.1
" 150	0.0041	17.3
" 200	0.0029	1.8
Through 200	0.0029	3.7

The small amount of fine material produced during crushing is an evidence of the logic in arranging stage crushing so that each type of machine has a comparatively small amount of work to do, as judged by mass reduction and not by capacity. Rolls refuse to operate when expected to effect a large reduction in particle-size; they can be operated at a low efficiency when reduction ratio is considerable; they work well when called upon to effect a reduction in the ratio of about four to one. Other machines, like the ball-mill, can be made to produce a finished product in one operation; but the result is usually uneconomical. In large-scale operations, as at Chuquicamata, the success of leaching is largely due to the fact that so many machines are necessary, in any case, that reduction in particle-size in several stages is more practicable than in the case of smaller enterprises. The moral, however, is the same in every case. The simplicity resulting from a restriction in the number of stages of crushing is more than offset by the actual mechanical inefficiency of crushing and the undesirable character of the product.

The dusting problem, in and around the fine-crushing plant, is a serious one; much discomfort results from the acidity of the particles on the mucous membrane of nose and mouth, and operations are rendered increasingly difficult. Masks are worn but the evil is not cured thereby. The rapid conveyance of immense tonnages of crushed ore necessitates an unavoidable amount of dusting, which cannot be avoided. Much has been accomplished in reducing the nuisance by enclosing the secondary crushers as much as possible. No system of vacuum abstraction of dust would appear to be feasible. The changes that have been made in the crushing department are principally in connection with the substitution of Symons disc-crushers in place of the high-speed rolls that were installed originally. Experiments have been made with the idea of using mechanical screens before the ore reaches the final crushers. This would doubtless

serve to by-pass a proportion of the material that at present goes to the crushing plant, and so reduces capacity. The dusting problem, however, is one that may detract from the practicability of the scheme.

An elaborate system of cross-conveyors is used to carry the ore to the leaching-vats, three Vezin machines being used to cut a final sample of about 400 lb. from each charge of 10,000 tons, or thereabout. The main conveyor, 36 in., which runs along the length of the leaching-vats, has a rise of about 12 feet and trips on to the filling-belt, also 36 in. wide. This filling-belt delivers con-



SPRAYING THE ORE AS DISCHARGED ONTO THE GRIZZLEY THAT PRECEDES THE CRUSHER

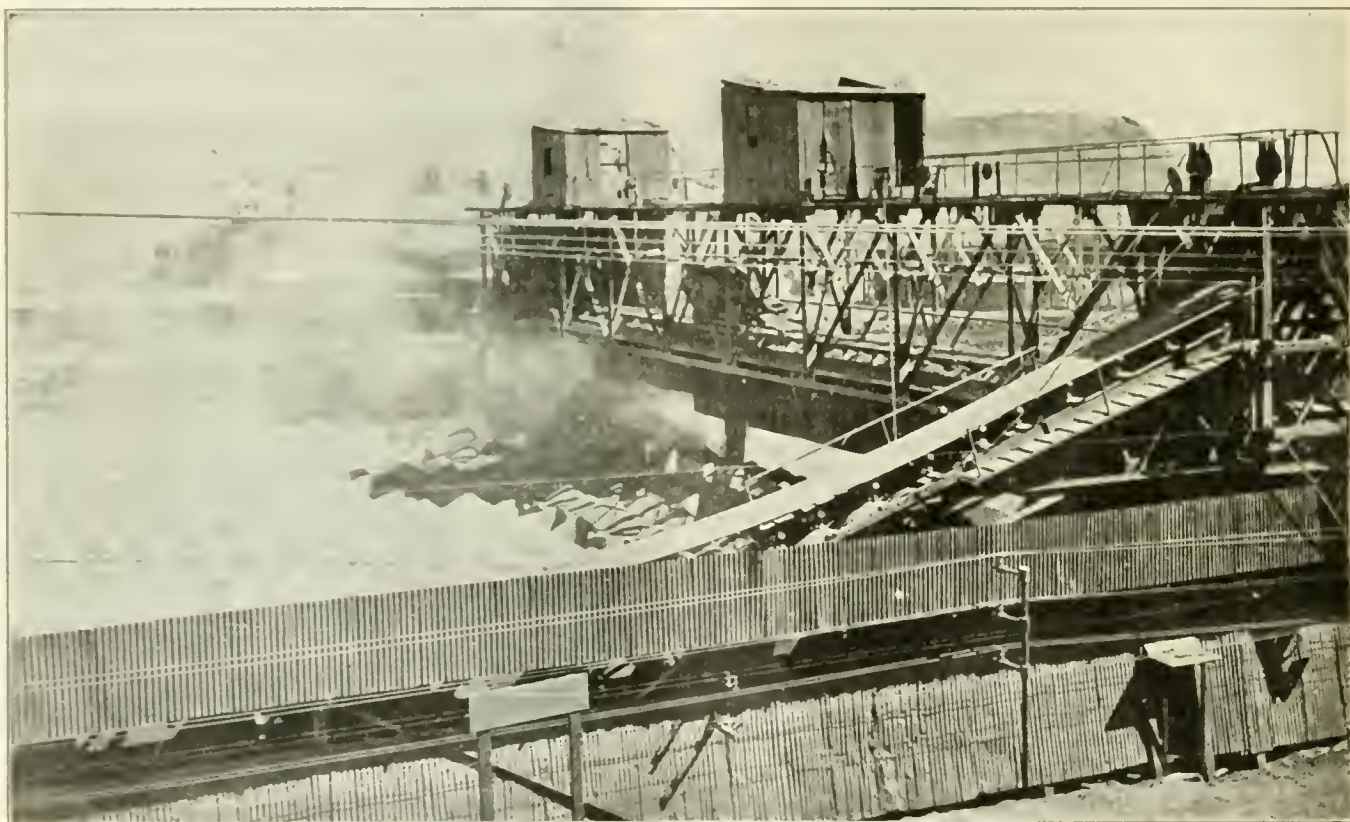
tinuously across the vat and has a traveling tripper that ensures the even discharge of material into the vat, as shown in the accompanying halftone. The time taken to fill a vat is usually between 12 and 14 hours. A Merrick weightometer is used to determine the tonnage.

The leaching-vats are constructed of reinforced concrete, and are mounted on piers that are set above the ground; rubber expansion joints are used. The insides of the vats are lined with a mastic mixture made of 75% sand and 25% (mixed) asphalt, the latter being manufactured by the Barber Asphalt Paving Co. The floor of the vat is merely covered with this mixture; the sides are first covered with a layer of expanded metal, into which the asphalt mixture is afterward embedded. Six of the original vats in the plant were 150 ft. long, 110 ft. broad, and 16 ft. deep; the depth has since been increased to $17\frac{1}{2}$ ft., which gives them a capacity of well over 10,000 tons per charge. Three newer vats are of the same length and width, but have a depth of 19 ft. 6 in.;

vats to be constructed in the future will be of this depth.

On the mastic floor of the vat are laid timbers, each 6 by 6 in., and spaced at 18-in. centres. These are sawn out on the under side, to allow for the free passage of solution in the direction of the exits. On these bearers is placed a grid of 2 by 6-in. planks, spaced $1\frac{1}{2}$ in. apart, coco-matting being laid on this. The shoveling-slats are also of 2 by 6-in. material; they are laid flat and at right angles to the grid planks, and are spaced about $\frac{3}{4}$ in. apart. No particular care is taken in the laying of the coco-matting, or in caulking at the edges. A proportion of dead ore is allowed to remain in the vat and is not removed by the grab-bucket. There is so little resistance

the possible utilization of a permanent sand bottom. I introduced this method of bottom construction several years ago at a cyanide leaching plant that was equipped with 200-ton vats, but I do not know if it has ever been tried on anything like so large a scale as the vats used in copper leaching at Chuquicamata or Ajo. In the smaller vats it worked excellently. With the larger plant it might be suggested that the bottom of the vat should carry the 6 by 6-in. timbers, arched underneath to facilitate solution flow. These bearers would be spaced as required, and would act as a support for other timbers of the same size, placed crosswise and on top of them, and in the line of action of the grab-buckets. These, too, would



A 10,000-TON LEACHING-VAT BEING FILLED

to the flow of the solution, thanks to the filling of the vat by automatic methods and the even distribution of fine ore, that the chance of a short-circuit of slimy solution is unlikely. The actual area of percolation represents no more than about 11% of the area of the vat bottom; this will give an idea of the ease with which leaching is carried out. At the same time, it compels attention to the fact that only a negligible proportion of the coco-matting in the vat is utilized; about 90% lies underneath the shoveling slats; it rots there, and has to be replaced about every five years. The cost of treatment at Chuquicamata is so low, on account of large-scale operation and efficient control, that if all the expense of the coco-matting were avoided, the net result per ton would be negligible. There is, however, the question of the cost of labor in replacing the bottoms: and on this account I had the temerity to suggest to the manager

be spaced, as are the present shoveling slats, to allow for the percolation of the solution. The spaces between the timbers would be filled with stone, gravel, and sand, of graduated sizes, and arranged so that each smaller size would pack on top of, but without falling through, the size larger below. The class of material to be used for the surface layer would depend on the composition of the charge being leached. A fairly coarse sand would be feasible in most cases. It would seem that such a bottom, when once laid and laid properly, should be as permanent as the bottom of the vat. Care, of course, must be taken that the shoveling slats are not shifted during the operation of the grab-buckets; but otherwise I can see no obstacles against practicability.

The point that is not generally understood in leaching work is that the bottom, if it functions properly, does not act as a filter. If that were its function it would choke

almost immediately after downward leaching were commenced; or a muddy solution would appear underneath. The function of the bottom is to offer an adequate support for the charge, preventing any movement whatsoever of solids in the direction of solution flow; it allows for the even distribution of solution during upward submergence of the ore, thus obviating channeling; and it permits the efficient drainage of the charge at the conclusion of leaching. The use of the term 'filter-bottom', as a designation of the support for the charge in a leaching-vat, has led to a great deal of misconception on the subject; I am sorry to say that I only realized this fact recently. The coco-matting or sand does not act as a filter in any way. Clear solutions can be obtained by leaching under proper conditions and whether upward or downward percolation is being practised. The solutions drawn from the top of a charge are almost as clear, assuming correct operation, as the solutions that are drawn from underneath the bottom support; no filtration occurs on the surface, obviously; and none is necessary along the plane of the bottom support. The actual amount of slime in contact with the bottom support is infinitesimal; if the charge is properly proportioned and the rate of percolation is normal, then no more should be carried there by the solution.

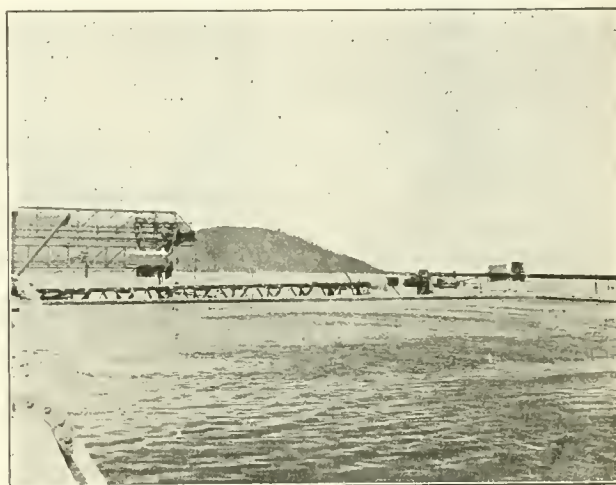
Each leaching-vat at Chuquicamata is equipped with eight 6-in. drain pipes; these are fixed in the bottom and are caulked with hard lead; they converge to a large main drain that goes to the pump-house. A good deal of experimentation has been carried out with regard to the best class of piping material to use. Lead-lined iron was first adopted, but this has been superseded partly by pipe that is made of asphalt mastic and partly by wood pipe, the outside of which is protected by a coating of tar.

The accompanying halftone gives a good idea of the method of filling, as well as the billowed appearance of the top of the vat when full. A small amount of segregation occurs during the filling; this is intentional; a small proportion of large gravel slides down the natural slope that is formed, and a bed is made at the bottom, on which the charge rests. However, as seen from the screening analysis quoted previously, the amount of true slime in the ore is exceedingly small, the proportion of material that would pass through a 200-mesh screen being under 4% of the weight of the charge; and through a 150-mesh screen, less than 6%. The whole mass, therefore, is easily leached; the possible rate of percolation being far in excess of the operating rate, it is obvious that leaching is remarkably uniform and satisfactory.

The system used in leaching is entirely by downward percolation, after, of course, upward submergence of the charge in the first instance; the rate of flow during normal leaching amounts to about 24 in. per hour, measured above the surface of the charge. The flow from each vat is intermittent, a variable amount of soaking being customary, largely because of the need to regulate the flow of solution to the electrolytic department. No circulation of solution in individual vats is practised; it is questionable whether this is a logical procedure in any

leaching operation; any good effects are usually nullified by the fact that the soluble is removed by the solution, only to be again put in contact with the charge; so that whereas the amount of undissolved material in the charge is lessened in amount, the dissolved material in the liquid in the charge, a proportion of which must necessarily be left in contact with the charge as entrained liquor or moisture, is higher in dissolved material than before circulation was commenced.

All treatment solutions used at Chuquicamata consist of spent electrolyte from the tank-house, together with a portion of the wash solution that is moved forward. The acidity is kept constant (about 5.5%) by the addition of sulphuric acid if necessary. During 1920, 2.64 lb. of acid was used per ton of ore treated; at the present time no acid is required. The treatment solution is enriched



TOP OF LEACHING-VAT

in copper by passage through a partly leached charge of ore, after which it comes in contact with fresh ore, remaining thus for a period that varies from 4 to 24 hours. The first effluent, which carries about 46 grammes of copper per litre, then goes to the de-chloridizing and precipitation department. The total time of treatment is about four days, the last day being set aside for water wash and drainage. The amount of water used amounts to about 0.15 ton per ton of ore; the last drain from the vats usually carries about 4 gm. of copper per litre of solution; the amount of moisture in the residue usually averages about 8%. A small proportion of the first effluent (about 15%) is set aside for almost complete precipitation of the copper content, after which it is allowed to run to waste. As with the cyanidation of gold and silver ores, an inevitable fouling of the solution is the result of the continuous re-use of the solvent; from every standpoint it is logical to discharge a small amount at frequent intervals. The water that must be added to displace the copper solution from the charge is in excess of the amount in the residue, an appreciable proportion is lost by evaporation, a small amount by wastage; the remainder must be discharged. The impurities that accumulate in the solution are mostly sulphates of potas-

sium, sodium, and magnesium; nitrates also accumulate and are derived from the salts found in such quantity on the near-by pampa; the nitric acid content of the solution is kept below a maximum by the practice of discharging a proportion of the effluent as barren solution.

In view of the comparative coarseness of the leaching product, the extraction of copper is remarkably high; the results are convincing as demonstrating the fact that large scale leaching operations are attended with the same or better metallurgic results than small-scale ones. The data from one of the charges that was finished during my stay on the property (on Sept. 21, 1920) were as follows:

Copper in charge	1.71%
Chlorine	0.06%
Copper in residue	0.112%

These figures showed a residue loss of only 6.2% of the copper in the charge; I was told, however, that the result was slightly above the average; the amount of chlorine present was low. On the basis of copper dissolved, as determined by solution assays and tonnages, and the assay of residue, the figures indicated an actual loss of copper in residue of only 6%—thus showing a close agreement with the loss as estimated by the assays of head and tail samples alone. The weight of the charge was 10,998 metric tons, and the total time of treatment was four days. The average loss of copper in residue during 1920 amounted to 7.88% of the copper in the ore treated.

(To be Concluded)

The Gold Premium

At a recent meeting, in London, of the Ivanhoe Gold Corporation, a company operating a mine at Kalgoorlie, in Western Australia, the following remarks were made by Francis A. Govett, the chairman:

"The premium on gold depends on two factors—first, the actual scarcity of the metal itself; and, secondly, the New York exchange, which is just a pressure-gauge indicating the varying balance of indebtedness of Great Britain to America. The scarcity of gold is being exaggerated now by increased demands and by reduced production consequent on the high cost of its production, the main factor in which is the cost of labor. That would seem to point to some possibility that production may continue to decrease, and so increase the premium, and may set off against the company's increased cost. That, however, need not be considered now; still, if only there were in the world a sufficient supply of gold, it would seem that the debtor nations would be sooner able to pay in gold, and the premium would disappear. But so far from there being a sufficient supply, the world's production is now not more than £70,000,000 sterling, against the pre-war output of £93,000,000, and under the present circumstances, as the existing mines grow older and poorer, unless new mines are found to take their place, or unless working costs can largely be reduced, the production is likely still to grow less. At the same time, nations are

now competing for gold, and all the while there is one constant drain, a perfect sink—namely, India. I have seen a computation, which I believe to be correct, that in 21 years to 1919 no less than £253,000,000 of gold has disappeared into hoards in India, which is the result of closing the Indian mints to silver in 1893, since when they have hoarded gold instead of silver—a process that is still going on. There is not the smallest chance of the re-opening of the Mint in India to silver, so as to relieve the gold, which is the course that I would take, and restore the normal monetary standard of the East with its sentimental associations and traditions derived from immemorial usage. One of the two factors, then, is distinctly in favor of the maintenance of the premium, and, therefore, of the continued existence of the Ivanhoe Gold Corporation.

"That being so, we have only to guess at what is likely to be the future of the New York exchange—that is to say, of our probable balance of trade and of our international indebtedness—in order to draw a fair conclusion as to the maintenance of the gold premium. If the proposal I submitted at the Zinc Corporation meeting in 1919 had been carried into effect, that all international war debts should mutually forthwith be cancelled, though it is true it would not have altered the balance of trade it would have enormously altered the international position of indebtedness, which is a vital factor in the exchanges. My own opinion is that the balance of trade will continue to be adverse and that the gold premium will long continue with varying force; therefore the shareholders can console themselves that even if they have to pay a proportion of the increased price for their bread and meat, and everything that they may want and America produces, they can set off still against it some profit from the Ivanhoe mine—as long as the richer stopes hold out—from the gold premium."

BONANZA MINING, states a U. S. Geological Survey bulletin, is a most powerful agency in attracting population, in forming communities, and in establishing transportation systems. Such mining will continue, for the known bonanza deposits in Alaska have been by no means exhausted, and there is a good prospect of finding others. A stable and permanent mining industry cannot, however, be founded on the exploitation of only the very rich orebodies. Permanency must be based on the development of the larger deposits of lesser unit value. Such development depends for its profits not so much on the richness of the ore as on economies made possible by the magnitude of the operations. Large mining operations cannot be successful at places that are served only by the haphazard and expensive means of transportation generally available on the frontier. The passage from bonanza mining to a stable and permanent industry has naturally taken place in all mineral-bearing regions and has long been under way in the accessible coastal regions of Alaska, but the great mineral wealth of the interior remains practically untouched except by the bonanza miner.

Blasting With Liquid Air

*The essential of every blasting agent is the instantaneous combustion and gasification of its two chief components within fractions of a thousandth part of a second, these two chief components being carbon and oxygen combined as indicated by the formula $C + 2O = CO_2$. Formerly the oxygen contained in Chilean saltpetre ($NaNO_3$), was utilized in its combination with nitrogen. Since 1914, however, a new method that allows the use of oxygen in the liquid state has been developed in Germany. The oxygen is combined with a carboniferous agent to form carbonic acid (CO_2). This causes the sudden development of large quantities of gas. Linde was the first to suggest the combination of liquid oxygen with carbon and of utilizing this mixture as an explosive. This was 20 years ago; but it was not until 1914 that the prejudices against this method were finally overcome.

SOAKING- AND TRANSPORTING-VESSELS. The failure of many experiments during the preliminary stages was due to the lack of suitable soaking- and transporting-vessels; but progress was achieved when the Liquid-Air Explosive Co. succeeded in designing a suitable flask. These flasks (Fig. 1) consist of metal spheres with double walls: the surfaces are highly polished where they are in contact with vacuum, radiation being thus prevented. The space between the spheres is evacuated, and contains a carbon substance of special composition. If the flask be now filled with liquid oxygen, the temperature of the carbon substance drops to about -180° . At this temperature the filling develops a considerable degree of absorptive power and acts as a highly efficient air pump, absorbing the last traces of air that may still be contained in the intervening space.

As the volumetric ratio of liquid air as compared with atmospheric air is 1 to 800, the flasks must never be sealed entirely. The warm air of the surrounding atmosphere has little access to the interior of the flask, the neck being made with a small inner diameter, thus rendering the emptying of the flask slow and difficult. This drawback was overcome by the Heylandt patent, according to which the neck of the flask is made as long as possible, so as to allow the inner flask to swing within, and support itself against, the outer one on being tilted (Fig. 2). In this manner metal touches metal at the point of contact, thereby causing an exchange of heat, which results in the liquid in the flask being vaporized. The pressure of the gas in the flask is then utilized for forcing out the liquid air. These flasks are made in various sizes, and possess capacities ranging from 1 to 150 litres. The larger sizes of flasks are used for storing the stocks in hand; the smaller sizes of 3, 5, 10, 15, or 25 litres contents convey the liquid air to the pit. Near the place of employment the liquid air is poured into special soaking-vessels as illustrated in Fig. 3. These soaking-vessels

have capacities varying between 2 and 14 litres; they are cylindrical in shape and also possess double walls, the space between them being evacuated and containing an absorptive carbon substance, as in the case of the flasks. After inserting the cartridges in the vessel, a small quantity of liquid air is first poured into it, in order to create

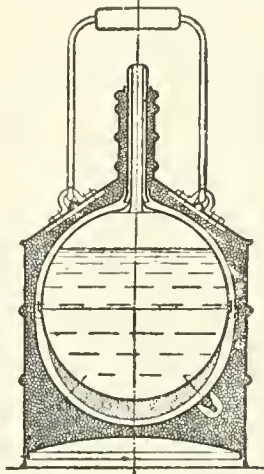


Fig. 1. Flask with Protective Casing

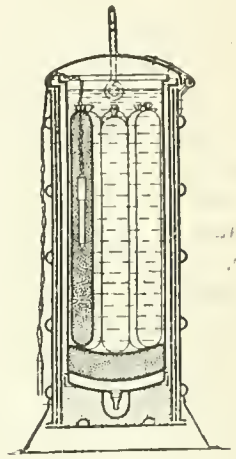


Fig. 3. Soaking-Vessel

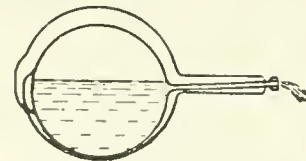


Fig. 2. Heylandt Flask, Tilted

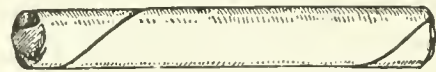


Fig. 4. Liquid-Air Cartridge

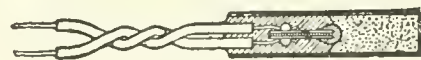


Fig. 5. Special Priming

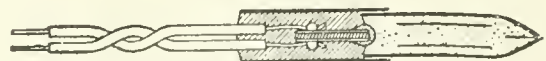


Fig. 6. 'Vulcan' Priming, with Liquid Detonating Cap



Fig. 7. Liquid-Air Cartridge, with Liquid-Air Detonating Cap Inserted

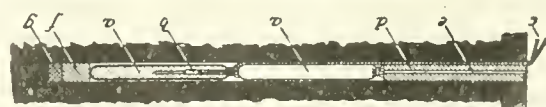


Fig. 8. Liquid-Air Detonating Cap, After Insertion in the Shot-Hole

a, Cartridge. b, Liquid-air detonating cap. c, Conducting wire for firing. d, Tamping. e, Gas escape (ventilating duct). f, Clay plug. g, Bore dust and chips.

the vacuum quickly through the action of the carbon substance when cooled down, thus preventing excessive vaporization of the contents. The vessel is then filled so that the cartridges become completely submerged; after a few minutes the cartridges are ready for use. Metal vessels are only used for transporting the liquid air; but

*Abstracted from an article by Bergassessor Lisse in 'Jour. Inst. Ger. Eng.' and re-printed in 'Engineering Progress'.

the employment of special glass has proved satisfactory for the construction of soaking-vessels. Experience has proved that metal vessels are superior to those of glass or porcelain. Moreover, the losses occurring in filling the vessels are far greater with glass and porcelain than in the case of metal.

THE CARTRIDGES. As the cartridges (Fig. 4) are not converted into explosives until after they have been soaked with liquid air, they can be stored or shipped unsoaked; there is no risk of fire or explosion. The cartridges are manufactured with different grades of explosive power by adding substances of higher temperature of combustion, more particularly various hydrocarbons, to the carboniferous substance. Aluminum and magnesium powder are also being used as admixtures.

Substances that are capable of absorbing a large amount of oxygen, as well as of retaining it for some time, are preferably used for the charge, the oxygen evaporating but slowly. Some types of liquid-air cartridges still give excellent blasting results even if 10 to 15 minutes have elapsed since their removal from the soaking-vessel. After the lapse of about half an hour the charge will have lost its explosive power, owing to the complete evaporation of the liquid air.

ELECTRIC PRIMING. Electric priming has proved to be the most reliable method of firing. The 'Vulkan' priming is the one employed with preference by the Liquid Air Blasting Co. It is easily enclosed in a protective casing that prevents the liquid air from affecting the active pill of the primer. If the inflammability of the cartridge has not been reduced by special admixtures, the special primer shown in Fig. 5 is equal to requirements, and produces a long jet flame of high temperature. It consists of a 'Vulkan' primer fitted with a special heading charge. The liquid-air detonator shown in Fig. 6, consists of two parts: the electric priming and the liquid-air detonating cap, stored separately and only fitted together just before being used. The liquid-air detonating cap consists of a small metal tube which is drawn to a point at its forward end. It possesses longitudinal slots, and is filled with a carboniferous substance resembling the contents of the cartridge. The cap is inserted deeply in the cartridge together with the electric priming (Fig. 7). On the cartridge being submerged in liquid air, the oxygen penetrates the cap through the longitudinal slots, and pervades the carboniferous powder contained in the cap. It is impossible to explode either the detonating cap or the cartridge without the presence of oxygen, but the iron cap forms a highly explosive detonator, when charged with liquid air. Fig. 8 shows a liquid-air detonating cap after insertion in the shot-hole.

FIRING BY TAPE-PRIMER. It should be noted that the fuse, if tape-priming is employed, must on no account be covered with gutta-percha or other inflammable material. These substances become brittle through the effect of cold, and may then catch fire at some point where the covering has broken, and from sparks. In such a case the match-cord rapidly burns to the cartridge, combustion

being facilitated by the oxygen present. It is therefore imperative to choose tape having a covering that is impregnated, for instance, with water-glass (potassium silicate), thus ensuring brittleness and unflammability.

In the case of soft shots of a powdery nature, it is possible to fire the blast by means of the jet flame of the tape-primer alone, and without the assistance of a detonating cap, provided that certain precautions are taken and that certain special types of liquid-air cartridges are used for the purpose.

The results obtained in blasting with liquid air are dependent on the choice as well as the method of priming.

ECONOMY OF LIQUID-AIR BLASTING. From an economical point of view this method has proved to be exceedingly satisfactory. After it had been in use for several months in Upper-Silesia in 1915, the cost of the explosive was lower even than in times of peace. The economy of the method is due by a comparatively small consumption of explosive.

SOUTH AFRICAN ASBESTOS. The extensive deposits of asbestos in South Africa have, according to the 'S. A. Mining and Engineering Journal', produced a considerable tonnage of fibre for the past 25 years. Production has been chiefly of blue asbestos or crocidolite from Cape Colony, and chrysotile asbestos from the Transvaal, Natal, and Rhodesia. The 'Cape blue' asbestos is mined chiefly by the Cape Asbestos Co., but lately some other companies have operated in the northern section of the deposit. Such companies, through lack of experience, have turned out a product less carefully graded than that of the Cape Asbestos Co., and have thus tended to lower the standard of blue asbestos. It is claimed that the blue asbestos requires special treatment to prepare it for consumers and, in order to build up a reputation for blue asbestos in the United States, a new corporation associated with the Cape Asbestos Co., and known as Consolidated Asbestos, Ltd., has recently been chartered under the laws of New Jersey. The offices are at 8 West 40th St., New York City, and the works at Bound Brook, N. J. It is the purpose of this corporation to prepare all crude blue fibre for carding machines by a special process. An important feature of the South African industry in the recent production of 'amosite', a ferrous amphibole with or without soda, and somewhat similar to crocidolite, though its color is ash gray to pale brown. A notable characteristic of the material is its fibre length, which reaches a maximum of 11 in. The product from one deposit averages 6 inches in length, and is said to be of good spinning quality. Amosite occurs over an area 60 miles long and 3 miles wide along the Olifants river in the Transvaal. It was discovered in 1907, and commercial production began about 1916. The supply is evidently great and an increasing market for the fibre is to be expected. There has recently been an important development of an amosite property in Secocoeniland, and output is increasing. The Egnep and Amosa Syndicate mines are in a good condition and large quantities of amosite are said to be available.

Proposed Revision of the Mining Law

The following is the text of a proposed bill prepared by a committee of well-known mining engineers appointed in January 1917 by the Director of the Bureau of Mines, to whom it was recently transmitted.

A Bill to revise, amend, and codify the laws of the United States relating to the location of mining claims on the public domain, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That this Act may be cited by the short title of "United States Mining Act". Wherever the word "person" occurs in this Act it shall be construed to import the plural or singular as the case demands, and shall include individuals, associations, partnerships, and corporations.

Sec. 2. In all cases lands valuable for minerals shall be reserved from sale, except as otherwise expressly directed by law.

Sec. 3. With the exceptions hereinafter noted, all valuable mineral deposits in lands belonging to the United States, both surveyed and unsurveyed, are hereby declared to be free and open to exploration and purchase, ownership and operation, and the lands in which they are found to occupation and purchase, by citizens of the United States and those who have declared their intention to become such, under regulations prescribed by law. Provided, that this Act shall not affect deposits of potassium, coal, phosphate, sodium, oil, oil shale, or gas; nor shall it pertain to withdrawals of public land which may have been, or may hereafter be, made; nor shall it apply to lands acquired under the Act of March first, nineteen hundred and eleven (Thirty-six Statutes, page nine hundred and sixty-one) known as the "Weeks Law".

Sec. 4. Proof of citizenship, under this Act, may consist, in the case of an individual, of his own affidavit thereof; in the case of an association of persons unincorporated, of the affidavit of their authorized agent, made on his own knowledge or upon information and belief; and in the case of a corporation organized under the laws of the United States, or of any State or Territory thereof, by the filing of a certified copy of its charter or certificate of incorporation.

Form and size of Claim—Requirement as to discovery— Exploration on land classified as nonmineral.

Sec. 5. A. Every full mining claim upon unsurveyed lands shall be located in the form of a square containing forty acres laid out on cardinal lines, conforming to the system of public land surveys, but claims may also be located in the form of a square containing ten acres laid out on cardinal lines, conforming to the system of public land surveys. Other fractional claims shall be located in the same manner as full claims, but their area and form may be governed by available areas. When mining claims are located upon surveyed lands they shall conform to the sub-divisions of the public land surveys. A full mining claim on surveyed lands shall be a quarter-quarter section or lot, but legal sub-divisions of forty acres may be sub-divided into ten acre tracts. Other fractional claims on surveyed lands shall be located in the same manner as full claims but their area and form may be governed by available areas.

B. Subject to limitations contained in this article, discovery of valuable mineral shall not hereafter be necessary in order to locate and hold a mining claim, but when a claim is recorded in the United States Land Office, the records shall include a sworn statement as to whether or not a discovery has been made. A claim located and recorded with-

out discovery on land classified as mineral may be held for five years without discovery, after which it shall be open to relocation under the same conditions as though it were a claim upon which the required expenditure for development had not been made; provided however that upon failure to make discovery within the period of five years a locator shall have the right to hold the claim or claims for further annual terms, not exceeding five years, by payment into the United States Land Office annually in advance fifty dollars for each acre or fraction thereof, which annual payments shall be in lieu of any further requirements for assessment work.

C. Should the owner of a claim located without discovery of valuable mineral make such a discovery during such five-year period, or during such five-year extension thereof, as stipulated in article B of this Section, he shall file a sworn statement as to that fact with the other papers in the United States Land Office, showing the nature of such discovery and of the mineral discovered. Upon the verification of such discovery by a United States deputy mineral surveyor, delegated by the officer in charge of said Land Office to make an examination, which examination shall be at the expense of the claimant, such discovery thus established shall entitle the owner of the claim to hold and possess it under the same conditions as though discovery had been made before the original record was filed in said Land Office. If discovery of a valuable mineral be made by drilling more than one hundred feet in depth, affidavits by at least two persons thoroughly acquainted with the facts, setting forth the nature of the discovery and the place, depth and time at which it was made, shall be accepted by the United States Deputy Mineral Surveyor, delegated by the officer in charge of said Land Office to make examinations, as prima facie evidence of discovery, provided that such affidavits be made within thirty days following the discovery.

D. Where no proceedings have been initiated in the United States Land Office to acquire a nonmineral estate in public land classified as nonmineral, mining claims may be located thereon with or without discovery, but in the absence of a discovery a subsequent location on such land shall not be recognized if made by the original locator, or by any person in privity with him, within two years after the prior location had become invalid.

E. One discovery shall be sufficient to support the holding and patenting of a maximum of four contiguous full-claims, aggregating 160 acres, (if held in common ownership,) or 16 contiguous 10-acre claims, aggregating 160 acres, if held in common ownership.

F. No person shall hereafter locate any mining claim or placer ground in Alaska as attorney for another unless he is duly authorized thereto by a power of attorney in writing, duly acknowledged and recorded in any recorder's office in the judicial division where the location is made. Any person so authorized may locate mining claims on placer ground for not more than two individuals or one association under such power of attorney, but no such agent or attorney shall be authorized or permitted to locate more than two mining claims on placer ground for any one principal or association during any calendar month. No person shall hereafter locate, cause or procure to be located, for himself, in Alaska, more than two such claims, not to exceed 20 acres each in the case of an individual, or 40 acres if an association, in any calendar month; and no such claim in Alaska which is longer than three times its greatest width shall hereafter be patented. Any claim attempted to be located in violation of this article shall be null and void, and the whole area thereof

may be located by any qualified locator as if no such prior attempt had been made.

G. Final entry and payment shall be made for all mining claims located hereafter within seven years from the date of the original location, exclusive of the time consumed in adverse suits and contests, except that in the case of extensions obtained under the provisions of article B of this section the time limit for final entry and payment shall be twelve years from the date of the original location.

H. In all cases of an application for a patent to mineral land a discovery shall be a condition precedent.

Marking, Notice, and Recording of Locations—Annual Development Work

Sec. 6. A. The location of a claim must be distinctly marked on the ground so that its boundaries can be readily traced, and such marking shall include the placing of a permanent monument extending not less than two feet above the ground at each corner of the claim. At the time when the claim is monumented there shall also be posted in a conspicuous place on the claim a notice of location which shall be according to a form prescribed by the United States Surveyor General and in conformity with the terms of this Act. All notices of location of mining claims hereafter made shall contain the name or names of the locators, the date of the location, and such a description of the claim or claims located by reference to some natural object or permanent monument as will identify the claim, and such notice of location of all claims, whether located before or after the effective date of this Act, shall be recorded in the United States Land Office for the district in which located; the claims located after the effective date of this Act shall be recorded within ninety days after the date of location; all claims located prior to the effective date of this Act shall be recorded within one year after said date.

B. On each claim located after the effective date of this Act, and until a patent has been issued therefor, not less than \$5 worth of labor shall be performed or improvements made during each year for each acre or fraction thereof comprised in such claim; or in lieu of the performance of such labor a sum computed at the rate of \$5 for each acre or fraction thereof may be paid each year, including the year of location, into the United States Land Office for the district; on each claim located after the tenth day of May, eighteen hundred and seventy-two and before the effective date of this Act, and until a patent has been issued therefor, not less than one hundred dollars' worth of labor shall be performed or improvements made during each year. On all claims located prior to the tenth day of May, eighteen hundred and seventy-two, ten dollars' worth of labor shall be performed or improvements made during each year for each one hundred feet in length along the vein until a patent has been issued therefor; but where such claims are contiguous, and are held in common, such expenditure may be made upon any one claim.

C. Upon failure to comply with the conditions as to annual work or payments, as provided in article B of this section, the claim or mine upon which failure occurred shall be open to relocation in the same manner as if no location of the same had ever been made, provided that the original locator, or locators, or any person, or persons, in privity with him or them, shall be disqualified for a period of one year from making such relocation and a resumption of work shall not save the original locator, or locators, their heirs, assigns, or legal representatives from the effects of such failure. Provided further; That a sale to an innocent purchaser for value after such failure and after such resumption shall cure such failure in the absence of a relocation prior to such sale.

D. Upon the failure of any one of several co-owners to contribute his proportion of the expenditures required by the terms of article B of this section, the co-owners who have

performed the labor or made the improvements, or who have paid the equivalent thereof to the United States Land Office as is required by article B of this Section, may, at the expiration of the year, give such delinquent co-owners personal notice in writing or notice by publication in the newspaper published nearest the claim for at least once a week for thirteen consecutive weeks, and if at the expiration of ninety days after such notice in writing or by publication such delinquent should fail or refuse to contribute his proportion of the expenditure required by this section his interest in the claim shall become the property of his co-owners who have made the required expenditures.

E. The period during which the annual work is required to be done, as specified in this section, shall be the calendar year during which location of claim be made. Provided, that if it be impossible to finish the work begun during the calendar year of location, and if the work has been diligently and continuously prosecuted, completion of the work, by diligent and continuous prosecution thereof, in the ensuing calendar year shall hold the claim. Provided, however, that this permission may not be construed as a waiver of the performance of the obligatory assessment work during the second calendar year. Provided, further, that on claims located on placer ground in the territory of Alaska said annual work shall be done during the calendar year in which they are located, and regardless of the time of year in which location may have been made.

Extralateral rights and ownership of all minerals and surface embraced within the claim

Sec. 7. Subject to the existing extralateral rights of mining claimants or patentees, the holder or patentee of a mining claim located hereafter shall have the exclusive right of possession and enjoyment of the surface held by him and of the minerals covered by this Act which lie beneath the claim and within vertical planes passing through the surface boundaries of said land, but shall not have the right to follow any mineral deposit beyond said planes. And the holders or patentees of claims heretofore located shall have similar exclusive possession of all the minerals covered by this Act which lie beneath the claim and within vertical planes passing through the surface boundaries of said land that is not covered by any existing extralateral rights.

Proceedings for patent

Sec. 8. A. A patent for any land claimed and located for valuable deposits may be obtained in the following manner: Any person, association, or corporation authorized to locate a claim under this Act, having claimed and located a piece of land for such purposes, and having complied with the terms of this Act, may file in the proper district land office an application for a patent, under oath, showing such compliance, together with proof of a discovery of valuable mineral, together with a plat and field notes of the claim or claims in common, made by or under the direction of the United States surveyor-general, showing accurately the boundaries of the claim or claims, which shall be distinctly marked by monuments on the ground. The claimant shall post a copy of such plat, together with a notice of such application for a patent, in a conspicuous place on the land embraced in such application previous to the filing of the application for a patent, and shall file an affidavit of at least two persons that such notice has been duly posted, and shall file a copy of the notice in such land office.

B. Upon compliance with the terms of article A of this Section the claimant shall be entitled to a patent for the land, in the manner following: The register of the district land office, upon the filing of such application, plat, field notes, notices, and affidavits, shall for the period of sixty days, publish a notice, that such application has been made, in a newspaper to be by him designated as published nearest

to such claim; and he shall also post such notice in his office for the same period. The claimant at the time of filing this application, or at any time thereafter, within the sixty days of publication, shall file with the register a certificate of the United States surveyor-general that twenty dollars' worth of labor has been expended or improvements made upon the claim by himself or grantors for each acre of the claim; or that cash has been paid into the United States Land Office to an amount bringing the total expenditure up to twenty dollars for each acre of the claim; and that the plat is correct, together with such further description by such reference to natural objects or permanent monuments as shall identify the claim; and shall furnish an accurate description to be incorporated in the patent. At the expiration of the sixty days of publication the claimant shall file his affidavit, showing that the plat and notice have been posted in a conspicuous place on the claim during such period of publication. If no adverse claim shall have been filed with the register and the receiver of the proper land office, at the expiration of the sixty days of publication, it shall be assumed that the applicant is entitled to a patent, upon the payment to the proper officer of five dollars per acre, and that no adverse claim exists; and thereafter no objection from third parties to the issuance of a patent shall be heard, except if it be shown that the applicant has failed to comply with the terms of this Act. Provided, however: That in the District of Alaska adverse claims authorized and provided for in this and the following section may be filed at any time during the sixty days' period of publication or within eight months thereafter, and the adverse suits authorized and provided for in the following section may be instituted at any time within sixty days after the filing of said claims in the local land office. Provided, further: That where the claimant for a patent is not a resident of or within the land district wherein the vein, lode, ledge, or deposit sought to be patented is located, the application for patent and the affidavits required to be made in this section by the claimant for such patent may be made by his, her, or its authorized agent, where said agent is conversant with the facts sought to be established by said affidavit.

Adverse claims against applications for patent

Sec. 9. A. Where an adverse claim is filed during the period of publication, it shall be upon oath of the person or persons making the same, and shall show the nature, boundaries, and extent of such adverse claim, and all proceedings, except the publication of notice and making and filing of the affidavit thereof, shall be stayed until the controversy shall have been settled or decided by a court of competent jurisdiction, or the adverse claim has been waived. It shall be the duty of the adverse claimant, within thirty days after filing his claim, to commence proceedings in a court of competent jurisdiction, to determine the question of the right of possession, and prosecute the same with reasonable diligence to final judgment; and a failure so to do shall be a waiver of his adverse claim. After such judgment shall have been rendered, the party entitled to the possession of the claim, or any portion thereof, may, without giving further notice, file a certified copy of the judgment-roll with the register of the land office, together with the certificate of the surveyor-general that the requisite amount of cash or labor has been expended or improvements made thereon, and the description required in other cases, and shall pay to the receiver five dollars per acre for his claim, together with the proper fees, whereupon the whole proceedings and the judgment-roll shall be certified by the register to the Commissioner of the General Land Office, and a patent shall issue thereon for the claim, or such portion thereof as the applicant shall appear, from the decision of the court, rightfully to possess.

B. If it appears from the decision of the court that several

parties are entitled to separate and different portions of the claim, each party may pay for his portion of the claim with the proper fees, and file the certificate and description by the surveyor-general, whereupon the register shall certify the proceedings and judgment-roll to the Commissioner of the General Land Office, as in the preceding case, and patents shall issue to the several parties according to their respective rights.

C. Nothing contained in this section shall be construed to prevent the alienation of a title conveyed by a patent for a mining claim to any person whatever. If, in any action brought pursuant to this section, title to the ground in controversy shall not be established by either party, the jury shall so find, and the judgment shall be entered according to the verdict. In such case costs shall not be allowed to either party, and the claimant shall not proceed in the land office or be entitled to a patent to the ground in controversy until he shall have perfected his title. The adverse claims referred to in this section may be verified by the oath of any duly authorized agent or attorney in fact of the adverse claimant cognizant of the facts stated.

Description of claims

Sec. 10. The description of mining claims upon surveyed lands shall designate the location of the claims with reference to the lines of the public survey. Where such claims are upon surveyed lands and conform to legal subdivisions no further survey or plat shall be required. Where patents have been or shall be issued for claims upon unsurveyed lands, the surveyor-general, in extending the public survey, shall adjust the same to the boundaries of said patented claims so as in no case to interfere with or change the true location of such claims as they are officially established upon the ground. Where patents have been issued for mineral lands, those lands only shall be segregated and shall be deemed to be patented which are bounded by the lines actually marked, defined, and established upon the ground by the monuments of the official survey upon which the patent grant is based, and surveyors-general in executing subsequent patent surveys, whether upon surveyed or unsurveyed lands, shall be governed accordingly. The said monuments shall at all times constitute the highest authority as to what land is patented, and in case of any conflict between the said monuments of such patented claims and the descriptions of said claims in the patents issued therefor the monuments on the ground shall govern, and erroneous or inconsistent description or calls in the patent descriptions shall give way thereto. Where by the segregation of mineral lands in any legal subdivision a quantity of agricultural land less than 40 acres remains, such fractional portion of agricultural land may be entered by any party qualified by law, for homestead or preemption purposes.

Surveys

Sec. 11. The surveyor-general of the United States may appoint in each land district containing mineral lands as many competent deputy surveyors as shall apply for appointment to survey mining claims. The expenses of the survey of mining claims, together with the cost of publication of notices, shall be paid by the applicants, and they shall be at liberty to obtain the same at the most reasonable rates, and they shall also be at liberty to employ any United States deputy surveyor to make the survey. The Commissioner of the General Land Office shall also have power to establish the maximum charges for surveys and publication of notices under this Act; and, in case of excessive charges for publication, he may designate any newspaper published in a land district where mines are situated for the publication of mining notices in such district, and fix the rates to be charged by such paper; and, to the end that the Commissioner may be fully informed on the subject, each applicant shall file

with the register a sworn statement of all charges and fees paid by such applicant for publication and surveys, together with all fees and money paid the register and the receiver of the land office, which statement shall be transmitted, with the other papers in the case, to the Commissioner of the General Land Office.

Verification of Affidavits. Notice of contest.

Sec. 12. All affidavits required to be made under this Act may be verified before any officer authorized to administer oaths. All testimony and proofs may be taken before any officer authorized to administer oaths within the land district where the claims may be situated, and, when duly certified by the officer taking the same, shall have the same force and effect as if taken before the register and receiver of the land office. In cases of contest as to the mineral or agricultural character of land, the testimony and proofs may be taken as herein provided on personal notice of at least ten days to the opposing party; or if such party cannot be found, then by publication of at least once a week for four consecutive weeks in a newspaper, to be designated by the register of the land office as published nearest to the location of such land; and the register shall require proof that such notice has been given.

Land required for mining purposes other than in mineral claims

Sec. 13. A. Where unoccupied land belonging to the public domain, not contiguous to a mining claim, is required by the proprietor of such claim for mining or metallurgical purposes, such non-adjacent land may be located and may be embraced and included in an application for a patent for such claim, and the same may be patented therewith, subject to the same preliminary requirements as to survey and notice as are applicable to mining claims; but no location hereafter made of such non-adjacent land shall exceed 10 acres, and payment for the same must be made at the same rate as fixed by this Act for a mining claim. The 10 acres of non-adjacent land provided for in this section must be in the form of a square, two sides of which must coincide with lines of the public survey. The owner of a mill, or reduction works, now owning a mine in connection therewith, may also receive a patent for his mill site, or works sites as provided in this section.

B. Where unoccupied land belonging to the public domain, either contiguous or noncontiguous to a mining claim, is needful in large areas for mining and metallurgical purposes, the surface rights of such land may be acquired in parcels or lots, conforming to the lines of the public surveys, without limit as to aggregate area, providing the application has been approved by the Secretary of the Interior. Land thus located and acquired under the provisions of this article shall be subject to the same provisions as to survey and notice as are required for the location and purchase of mineral lands in this statute; provided however that no land that has been officially classified by the Federal Government as being capable of irrigation from any known source may be located under the terms of this article. Lands located under this article shall be paid for at the rate of \$10 per acre.

C. The tenure of the surface provided for in article B of this section refers solely to the occupancy of the surface, and the mineral rights underlying land thus acquired shall be in all cases reserved and shall be subject to location and patent under regulations and provisions promulgated by the Secretary of the Interior in harmony with the general provisions of this Act governing the location of mineral lands.

Mineral Development Fund

Sec. 14. All moneys paid into the United States Land Office in lieu of annual labor or improvements and for extension of tenure beyond five years where no discovery has been made, as provided for in this Act are hereby reserved,

set aside, and appropriated, as a special fund in the Treasury, to be known as the "Mineral Development Fund", to be used and expended, under the direction of the Secretary of the Interior, within the State or Territory, and as nearly as practicable within the mining district, from which payments were made, for general purposes of developing the mineral resources of the several mining districts.

Special Provisions

Sec. 15. Whenever, by priority of possession, rights to the use of water for mining, agricultural, manufacturing, or other purposes, have vested and accrued, and the same are recognized and acknowledged by the local customs, laws, and the decisions of courts, the possessors and owners of such vested rights shall be maintained and protected in the same; and the right of way for the construction of ditches and canals for the purposes herein specified is acknowledged and confirmed; but whenever any person, in the construction of any ditch or canal, injures or damages the possession of any settler on the public domain, the party committing such injury or damage shall be liable to the party injured for such injury or damage.

Sec. 16. All patents granted, or preemption or homesteads allowed, shall be subject to any vested and accrued water rights, or rights to ditches, and reservoirs used in connection with such water rights, as may have been acquired under or recognized by the preceding section.

Sec. 17. The President is authorized to establish additional land districts, and to appoint the necessary officers under existing laws, wherever he may deem the same necessary for the public convenience in executing the provisions of this Act.

Sec. 18. Subject only to such general limitations as may be necessary to exempt navigation from artificial obstructions all land and shoal water between low and mean high tide on the shores, bays, and inlets of Behring Sea, within the jurisdiction of the United States, shall be subject to exploration and mining for gold and other precious metals by citizens of the United States, or persons who have legally declared their intentions to become such, under such reasonable rules and regulations as the miners in organized mining districts may have heretofore made or may hereafter make governing the temporary possession thereof for exploration and mining purposes. Provided: That the rules and regulations established by the miners shall not be in conflict with the mining laws of the United States; and no exclusive permits shall be granted by the Secretary of War authorizing any person or persons, corporation, or company to excavate or mine under any of said waters below low tide; but citizens of the United States or persons who have legally declared their intention to become such shall have the right to dredge and mine for gold or other precious metals in said waters, below low tide, subject to such general rules and regulations as the Secretary of War may prescribe for the preservation of order and the protection of the interests of commerce; such rules and regulations shall not, however, deprive miners on the beach of the right hereby given to dump tailings into or pump from the sea opposite their claims, except where such dumping would actually obstruct navigation; and the reservation of a roadway sixty feet wide, under the tenth section of the Act of May fourteenth, eighteen hundred and ninety-eight, entitled "An act extending the homestead laws and providing for right of way for railroads in the district of Alaska, and for other purposes", shall not apply to mineral lands or town sites.

Sec. 19. No act passed at the first session of the Thirty-eighth Congress, granting lands to States or corporations to aid in the construction of roads or for other purposes, or to extend the time of grants made prior to the thirtieth day of January, eighteen hundred and sixty-five, shall be so con-

strued as to embrace mineral lands, which in all cases are reserved exclusively to the United States, unless otherwise specially provided in the act or acts making the grant.

Sec. 20. No possessory action between persons, in any court of the United States, for the recovery of any mining title, or for damages to any such title, shall be affected by the fact that the paramount title to the land in which such mines lie is in the United States; but each case shall be adjudged by the law of possession.

Sec. 21. The Secretary of the Treasury is hereby authorized and directed to pay, out of the moneys heretofore or hereafter covered into the Treasury from deposits made by individuals to cover cost of work performed and to be performed in the offices of the United States surveyors-general in connection with the survey of mineral lands, any excess in the amount deposited over and above the actual cost of the work performed, including all expenses incident thereto for which the deposits were severally made or the whole of any unused deposit; and such sums, as the several cases may be, shall be deemed to be annually and permanently appropriated for that purpose. Such repayments shall be made to the person or persons who made the several deposits, or to his or their legal representatives, after the completion or abandonment of the work for which the deposits were made, and upon an account certified by the surveyor-general of the district in which the mineral land surveyed, or sought to be surveyed, is situated and approved by the Commissioner of the General Land Office.

Sec. 22. Where by special act of Congress land has been opened to exploration or exploitation under the mineral land laws of the United States but subject to any special limitation or condition expressed in such special act, this Act shall not be construed as waiving such limitation or condition.

Sec. 23. So much of the Act of August fourth, eighteen hundred and ninety-two (27 Statutes at Large, page 348) as provides for the entry of lands chiefly valuable for building stone under the provisions of the law relating to placer mining claims is hereby amended by striking out the word "placer", and hereafter this Act shall be substituted for the placer mining law in the making of such entries.

Sec. 24. The provisions of this Act shall not apply to public lands in the states of Michigan, Wisconsin, Minnesota, Missouri, Kansas or Alabama.

Repealing Section

Sec. 25. The following sections of the Revised Statutes, that is, section 2320, relating to the size of lode claims; section 2322, relating to rights in mining claims; section 2323, relating to tunnel rights; section 2338, relating to rights initiated prior to May tenth, eighteen hundred and seventy-two; section 2329, providing for the location of placer claims; section 2330, relating to placer claims; section 2331, relating to the survey and segregation of mineral lands; section 2332, relating to claims held for a statutory period and to liens on claims; section 2333, relating to the patenting of placer claims; section 2336, relating to intersecting veins; section 2338, relating to State rules for working mines; section 2341, relating to preemption and homestead entries of lands designated as mineral lands; section 2342, relating to the designation of agricultural lands; and section 2344, relating to rights acquired under prior existing law; also the Act of Congress approved June sixth, eighteen hundred and seventy-four (Eighteen Statutes at Large, page sixty-one) relating to expenditures of labor and improvements on mining claims; and the Act of Congress approved February eleven, eighteen hundred and seventy-five, (Eighteen Statutes at Large, page three hundred and fifteen) relating to tunnel work, are hereby repealed; Provided, That nothing contained in this Act, except as expressly provided, shall be construed to affect any right heretofore initiated.

Coalite

At a recent meeting of the Royal Society of Arts, Professor H. E. Armstrong dealt with the use and abuse of coal as fuel, and outlined the early history of coalite. Early in 1913 a large German company was about to associate itself with the English undertaking, but the War intervened, and it was not until 1919 that development work was resumed at Barnsley. A carbonizing plant built to the design of T. M. Davidson had been in operation since November 1920 and was undoubtedly a success. The trouble due to expansion of the fuel on carbonization had been overcome by building the ovens with upright walls and fitting them with perforated hanging plates movable in a vertical plane over a narrow range; the coal was filled into the space between the side of the oven and the opposed face of each plate, thus enabling the width to be varied. During carbonization the plates exerted pressure on the coal, and the volatile matter escaped through the perforations. When carbonization was complete, after 5 to 8 hours, the coalite slabs were allowed to fall into an air-tight water-cooled chamber. It was essential that the coalite should not be exposed to air during cooling. The product contained 10 to 15% of volatile matter and burned with a bright flame; the coal-oil was well within the Admiralty specification for fuel oils; and motor spirit could be obtained from the liquid and scrubbed from the gas.

In the discussion that followed, Sir Arthur Duckham said that the great drawback to the process was the lack of an absolutely satisfactory balance-sheet, and this was the reason why gas-engineers had fought shy of it; the success of the process would depend on the value of the coalite and the value of the oil. Dr. J. A. Harker said that in an investigation carried out under the auspices of the Ministry of Munitions, it was ascertained that from one ton of coal the yield of crude coalite was 14 cwt., of which rather less than 13 cwt. was salable. Economically, the process depended upon selling the 13 cwt. for the same price as that paid for one ton of coal, and of paying operating costs from the sale of by-products. He thought that the margin between profit and loss would be very narrow. Among the points raised by subsequent speakers were the friability of fuel produced by low-temperature carbonization processes and the necessity for briquetting, the economy that should be obtainable with the Neilsen process of internal-heating of the retorts with water-gas, and the need of eliminating as much ash as possible by properly washing the coal. In his reply, the author of the paper stated that the public should be prepared to pay more for coalite than for coal because it did not burn away so rapidly and was smokeless. The yield of fuel oil by carbonization was about 1 ton from 10 tons of coal.

ALCOHOL and dissolved acetylene is a combination that has been adopted as a motor fuel in South Africa. It can be made locally in unlimited quantities and is likely to supersede gasoline.

Company Reports

TENNESSEE COPPER COMPANY

Report for the year ended December 31, 1920.

Property: Mines, smelter, and acid plants in Tennessee.

Operating Officials: J. N. Houser, general manager; M. A. Cain, assistant general manager.

Financial: The Tennessee Copper & Chemical Corporation reports an operating profit for the year of \$162,650.53.

Development: Burra Burra mine, 5719 ft.; London mine, 1700 ft.; Polk Co. mine, 230 ft.; total ore-reserves, excluding those in the Eureka mine, 3,533,134 tons.

Production: 507,958 tons was smelted, for a total production of 10,474,881 lb. copper; sulphuric acid produced amounted to 333,629 tons.

BUTTE & SUPERIOR MINING COMPANY

Report for the year ended December 31, 1920.

Property: Mine and mill at Butte, Montana.

Operating Officials: C. Bocking, general manager; E. V. Daveler, general superintendent; A. McLeod, mine superintendent.

Financial: Operating revenue, \$3,779,276.43; net income, to surplus account, \$187,928.70. Balance of surplus, \$3,250,049.51.

Development: 16,981 ft., exclusive of diamond-drilling, which amounted to 856 ft.; ore-reserves, 422,100 tons, containing an average of 15.45% zinc, and 5.5 oz. silver.

Production: 334,919 tons was milled, of an average grade of 13.68% zinc and 5.41 oz. silver. The total production of zinc concentrate was 81,836 tons, containing 53.178% zinc, and 19.494 oz. silver per ton.

General: The company has acquired an interest in the Shasta Zinc & Copper Co.; it has also acquired the property of the Bully Hill Mines, Inc., California.

BUNKER HILL & SULLIVAN MINING & CONCENTRATING COMPANY

Report for the year ended December 31, 1920.

Property: Mines and mill in Coeur d'Alene district; smelter near Kellogg, Idaho.

Operating Officials: Stanly A. Easton, manager; H. M. Sullivan, smelter superintendent.

Financial: Operating profit, \$2,842,106.52; loss, \$561,066.39; dividends, \$1,962,000; dividends to date \$25,193,250.

Production: Ore mined, 409,986 tons; ore concentrated, 523,107 tons; concentrate produced, 96,489.37, containing 36.83% lead and 12.38 oz. silver per ton; net smelter returns, \$4,586,976.26.

General: Operating costs reached maximum during the year. Toward the close, however, more favorable operating conditions obtained, and beginning January 1 a reduction of \$1 per shift was made in the bonus paid to all employees. Operations at the Bunker Hill smelter and refinery were conducted continuously throughout the year with satisfactory results in every respect.

ANACONDA COPPER MINING COMPANY

Report for the year ended December 31, 1920.

Property: Extensive holdings in Montana and in Chile.

Financial: Gross income, \$9,335,253.18; net income, \$2,691,660.62; dividends, \$6,993,750.

Development: 22.55 miles, as compared with 20.39 miles in 1919.

Production: Mine, 2,152,763 tons of ore and 7557 tons of precipitates; copper reduction works treated 2,319,336 tons of ore and other material; the Anaconda works produced

155,339,576 lb. copper, 7,113,659.22 oz. silver, and 32,530,302 oz. gold; the electrolytic copper refinery at Great Falls produced 145,149,892 lb. cathodes; the copper-leaching plant at Anaconda treated 484,352 tons of tailing and 43,271 tons of purchased ore, from which was produced 5037 tons of cement copper; the copper concentrator treated by flotation 181,033 tons of slime from the ponds and 722,769 tons of tailing; the zinc plants treated 443,582 tons of ore and other material; at Great Falls, 101,332,458 lb. of electrolytic zinc was produced and 5,255,452 lb. of zinc in dross and residue, from which were produced 12,536,088 lb. lead, 2,173,080 lb. copper, 2,073,348 oz. silver, and 6151 oz. gold; at the rod-and-wire mill 22,326,478 lb. of copper was manufactured into wire, and 5,292,604 lb. was made into strand.

General: The leaching experiments carried out during the year at Portrerillos, Chile, indicated a consistent extraction of 92% of the copper content of the oxide ores treated. A sulphur di-oxide plant has been shipped to Chile.

RAY CONSOLIDATED COPPER COMPANY

Report for the year ended December 31, 1920.

Property: Mine and mill in Arizona.

Operating Officials: R. C. Gemmell, assistant managing director; C. A. Smith, superintendent of mines; W. S. Boyd, manager; L. S. Cates, general manager; H. C. Smith, superintendent of mills.

Financial: Net income and proceeds of depletion, \$911,675.24; dividends, \$1,577,179; dividends to date, \$25,412,620.67.

Development: 38,600 ft.; ore-reserves, 83,004,043 tons averaging 2.068% copper.

Production: mine, 1,732,341 tons; ore milled, 1,706,928 tons containing 1.720% copper; concentrate produced, 127,749 tons containing an average of 18.84% copper; net production, after allowing for smelter deductions, 47,062,930 lb. copper.

General: The cost of milling for the year was \$1.24 per ton as compared with \$1.29 for the previous year. The recovery of copper from the sulphides was 90.83%.

UTAH COPPER COMPANY

Report for the year ended December 31, 1920.

Property: Mines and mills at Bingham and Garfield, Utah, respectively.

Operating Officials: R. C. Gemmell, general manager; L. S. Cates, assistant general manager; J. D. Shilling, general superintendent of mines; J. D. Shilling Jr., superintendent of mines; H. C. Goodrich, chief engineer of mines; T. A. Janney, chief metallurgical engineer; D. D. Moffat, consulting engineer of mills; F. G. Janney, general superintendent of mills; R. Hatch, superintendent, Arthur mill; R. H. Hawley, superintendent of leaching plant; E. W. Englemann, consulting research engineer.

Financial: Net operating income, \$3,376,654.19; miscellaneous income, \$1,302,703.71; capital distribution from Nevada Copper Co., \$750,375.

Dividends: \$9,746,940; to date \$111,509,662.50.

Development: No attempt was made to add to the ore-reserves; remaining ore amounts to 364,130,800 tons averaging 1.35% copper.

Production: 5,556,800 tons was milled containing 1.16% copper. Recovery was 81.38%. The net production was 101,897,758 lb. copper, \$542,217.36 in gold, and \$281,116.14 in silver.

General: A suit for alleged infringement of patents was brought by the Minerals Separation Co., in the U. S. District Court for the District of New Jersey during the year. The report states that the answer will be filed in due course; stockholders are advised that the company has a good and meritorious defense.

Book Reviews

The New Stone Age. By Harrison E. Howe. 287 pp., ill. Published by the Century Co., of New York. For sale by 'Mining and Scientific Press'. Price, \$3.

This is one of the 'Century Books of Useful Science', known best through Edwin E. Slosson's admirable volume on 'Creative Chemistry'. The title might suggest a research into the history of primitive man, whereas the subject is the manufacture and use of artificial stone, more particularly cement and its derivatives, plaster and concrete. The ancients used sand-lime mortar; the Romans made a cement by mixing volcanic ash with burned limestone. The secret of this successful mixture, wherewith the Romans constructed their aqueducts, was lost for ten centuries. The modern cement industry started with the Eddystone lighthouse that was built by John Smeaton by aid of a water-resisting mortar that set under water. The previous lighthouses on the Eddystone rock had been wooden structures, although Mr. Howe does not say so. In 1756, the year in which Wolfe at Quebec won this continent for the English-speaking people, Smeaton discovered that an impure clayey limestone gave him a mortar superior to any then in use. He burned the mixture at a low temperature and used only the portion that would slake with water. In 1810 Edgar Dobbs, another Englishman, patented a so-called Roman cement, prepared from lime and clay. This mixture he formed into briquettes, which he burned, to expel the carbon dioxide, but he was careful not to vitrify his product. He, like his predecessors, hesitated to use the portion of his material that had undergone incipient fusion. Yet that was the best of it. In 1824 Joseph Aspdin, of Leeds, England, discovered that if the dust from limestone roads, or ground limestone in general, were mixed with clay, and burned at a higher temperature than any theretofore applied to such mixtures the resulting product after being pulverized yielded a material that hardened when mixed with water, and produced a stone-like substance like the building-stone quarried at Portland, on the coast of Dorset. Hence the name, Portland cement. It was used in the construction of the Thames Tunnel in 1828. The practice of burning the clay-limestone to fusion was then established.

In the United States the use of cement coincided with the building of a number of canals. The first cement produced in this country was derived from a rock near Chittenango, in New York, by an engineer employed on the Erie canal in 1818. The early cement-mills obtained their raw material from various rocks of the magnesian limestone type. Thus the Rosendale cement contained 35.61% calcium oxide, 27.75% silica, 21.18% magnesium oxide, 9.78% iron oxide and alumina. The broken rock was burned in kilns by aid of wood, at first, and coal, later. The clinker from these kilns was ground between burr-stones turned by water-power. The production of natural cement increased steadily in volume until 1899, in which year the output was 9,868,179 barrels. The production of artificial or portland cement has grown from 5,652,266 bbl. in 1899 to 80,287,000 bbl. in 1919. The use of barrels for storing and transporting cement has been discontinued, in favor of sacks, but the old unit of measurement survives. "The process invented by Aspdin is incapable of producing the cement that we know as portland cement", says the author, "for it is not burned at a temperature sufficiently high to produce the one essential ingredient, since discovered by scientific research". That ingredient is tricalcic silicate, in which three molecules of calcium oxide combine with one of silica. "In improving the process [of making cement] by raising the burning temperature to produce incipient fusion, which was accomplished about the year 1825, this constituent was formed, and, while the superiority of the cement so made was early

demonstrated, no one knew why it was better, nor why such burning was necessary to make it better. As in many other industrial processes, the process for manufacturing a superior product was accidentally discovered, but no one gave sufficient thought to why the steps found necessary were taken . . . To the Geophysical Laboratory of the Carnegie Institution of Washington belongs the credit of achieving the first considerable success in learning to what the cementitious character of portland cement is due. . . It would appear [from the experiments conducted by the Carnegie Institution] that the value of portland cement as a cementing material when mixed with water is due to one or more of the compounds—dicalcic silicate, tricalcic silicate, and tricalcic aluminate." Of these, the last one to form is tricalcic silicate, which, as already stated, is the essential constituent of good cement. To the hydration of these compounds is due the 'setting' of cement. The author quotes from George A. Rankin as follows: "When pure tricalcic aluminate is mixed with water, an amorphous hydrated material is first formed. This material sets and hardens very rapidly. The compound tricalcic silicate, when mixed with water, also sets and hardens rather rapidly. In the case of this compound, as in the case of tricalcic aluminate, the setting and hardening are due to the formation of an amorphous hydrated material on the individual grains, which are thus cemented together . . . From this . . . it will be seen that the setting and hardening involve the formation of an amorphous hydrated material which subsequently partially crystallizes; that the initial set is probably due to the hydration of tricalcic aluminate; that the hardness and cohesive strength at first are due to the cementing action of the amorphous material produced by the hydration of this aluminate and of the tricalcic silicate; and that the gradual increase in strength is due to further hydration of these two compounds together with the hydration of the dicalcic silicate." To produce the maximum proportion of the tricalcic silicate would require a temperature "much too high for economic industrial practice. The best cement-making practice today produces a portland cement containing from 30 to 35% of tricalcic silicate. . . The only conditions under which a larger percentage of lime can be used to convert more of the dicalcic silicate to the tricalcic silicate involves fineness of grinding and temperatures that are uneconomical, working with our present raw material."

Such is the history and the theory of cement-making as told by Mr. Howe. We have quoted enough to indicate the style of his writing, which is colloquial rather than literary. It is a mistake to describe things in terms of the words used for the things themselves, for example, when Swift defined an archdeacon as a person "who performed archidiaconal functions", he explained nothing. So it is a blunder to speak of the "cementitious character of portland cement" and of "the value of portland cement as a cementing material". Such simple and non-technical synonyms as 'binding', 'cohesive', and 'uniting' would serve the purpose better, particularly in a book intended for the general public. The author, at the start, might have told the non-scientific reader that limestone consists mainly of calcium carbonate and that the 'burning' of limestone expels the carbon dioxide, leaving the calcium oxide, or 'lime'. Instead, he uses 'lime' and 'limestone' interchangeably and confusingly. He might have explained that clay is aluminum silicate and that the tricalcic aluminate and silicate in cement come from combinations between the constituents of the clay and the limestone. The author uses 'economic' where he means 'economical'; he is guilty of substituting "preventative" (page 22) for 'preventive'; he employs a singular verb after 'data' ("enough data has been secured", page 43); he makes other lapses from correct literary form, but these will not annoy the average reader, who will give more attention to the matter than the manner of the author's writing, and he will

and the book pleasantly informative. However, it will be caviar to the general public, because it is written in a style likely to attract only those immediately interested in the subject; it is in no sense a book to 'popularize' science, and for that reason it is not in the class with 'Creative Chemistry', but it is worthy of being in a series of "books of useful science" and should be read by every engineer, simply because every engineer uses cement and its derivatives, and ought therefore to understand the nature of these common materials of construction and their methods of use in the arts.

Besides the history of cement and the manufacture of it, the book describes the by-products (notably potash) of the cement industry, the making of concrete, reinforcement, the testing of concrete, the use of cement and concrete in art, in highways, in railroads, in ships, tanks, houses, and in war. The chapter on concrete ships is particularly interesting. For this purpose a cement particularly "strong and plastic" was secured by means of especially fine grinding, namely, so fine that 90% passed a 200-mesh screen. "The aggregates must not exceed half an inch in size; and beginning with sand or gravel or volcanic ash, especially burned clay was ultimately devised. . . . One part of cement to one part of specially fused clay below one-quarter of an inch in size, and two parts of this clay between one-quarter and one-half inch in size, gives a concrete with compressive strength of 3380 pounds to the square inch after a seven-day period and 4350 pounds at 28 days. This concrete weighed only 106 pounds to a cubic foot, and made it possible to obtain a ratio of 62% of the dead weight of the total displacement for a 3500-ton ship, as compared with 65.68% for a steel ship and 53% for a wooden vessel. A 3500-ton concrete ship of the standard 150-lb. concrete contains 1761 tons of concrete, 400 tons of reinforcing steel, and 811 tons of wood fixtures, machinery, and equipment. It is seen, therefore, that the total weight of the ship without load is 2970 tons, and that a reduction in the weight of the concrete per cubic foot from 150 to 106 pounds is of decided advantage." This is interesting, but much of it is awkwardly expressed.

The steamship 'Faith', the most notable of the concrete ships launched during the War, has stood the test of service. It was feared that "engine vibration would cause a shattering of the material or the development of large cracks. . . . This has not proved to be the case". However, the author is wisely cautious in expressing a final opinion: "Concrete ocean-going ships are new, and we must wait a number of years for performance in actual practice to demonstrate to what extent they are efficient and reliable". It has been found that a small electric direct-current leakage "will cause weakening of the mortar at the cathode, if the action continues an appreciable time, with the result that the bond strength will decrease. . . . With alternating current these troubles are avoided". It is inadvisable, says the author, to use brass or bronze castings "adjoining steel reinforcement, since in the presence of an electrolyte there is at once the possibility of local electrolytic action". This, of course, is a technical platitude. The use of concrete in the construction of canal-barges has made considerable progress. "On such waterways they will not be subjected to sagging and hogging, nor to conditions that are responsible for the greatest stresses." Concrete is used for repairing holes in the hulls of vessels until a dry-dock becomes available. Indeed, I may add, travelers to Alaska have been intimidated by rumors that many old vessels so repaired are in use. Obviously the uses of cement are many and various; it is no stretch of imagination to consider this a "new stone age"; we live in an age of stone and metal, and the engineer has proved, in employing them, his traditional ability to utilize the resources of nature to the use and benefit of man.—T. A. R.

Artificial Light. By M. Luckiesh. 366 pp., ill. The Century Co., New York. For sale by 'Mining and Scientific Press'. Price, \$3.

As the author states in the preface, an endeavor has been made to discuss artificial light in a manner as devoid as possible of intricate detail. The early chapters deal particularly with primitive artificial light; their contents are mainly historical. The science of light-production may be considered to have been born in the latter part of the 18th century; beginning with that period, a few chapters deal with the development of artificial light up to the present time. Until the middle of the 19th century mere light was available, but as time progressed, the light sources, through the application of science, became more powerful and efficient. Gradually mere light grew to more light; in the dawn of the 20th century adequate light became available. In a single century, after the development of artificial light began in earnest, the efficiency of light production increased fifty-fold and the cost diminished correspondingly. The next group of chapters deals with various economic influences of artificial light and with some of the byways in which artificial light is serving mankind. In passing through the spectacular aspects of lighting, the author emerges into the esthetics of light and lighting.

The aim has been to show that artificial light has become intricately interwoven with human activities and that it has had a powerful influence upon the progress of civilization. The book has been prepared with care and is excellently illustrated. It will be read with interest by an appreciative audience.

Tin Resources of the British Empire. By N. M. Penzer. 358 pp., ill. W. Rider & Son, Ltd., 8 Paternoster Row, E.C. 4, London. Price, 15s.

This is the second volume of a series on the subject of the production and resources of the major essentials within the British Empire. The book commences with a brief historical sketch of tin production and a description of the stanniferous ores and minerals. The subject is then considered on the basis of geographical distribution, from which an idea can be formed as to the extent of the deposits within the Empire. An exhaustive study has been made of the deposits in the following districts and countries: Cornwall and Devon, Scotland, and Ireland, in Europe; Malaya, India, Ceylon, Hongkong, in Asia; Nigeria, Gold Coast, Nyasaland, Union of South Africa, Rhodesia, and 'German' South-West Africa, in Africa; Canada in America; and Australia, Tasmania, and New Zealand, in Australasia. The book concludes with an account of the industrial applications, the prices, sales, and the world's output of tin, and a complete bibliography of the subject is appended. It will prove of value as a reliable work of reference.

Gasoline Automobiles. By James A. Moyer. 261 pp., 52 by 8, ill. McGraw-Hill Book Co., New York. For sale by 'Mining and Scientific Press'. Price, \$2.

The purpose of this book is to present the essential features of automobile construction and operation, with particular reference to the gasoline-driven machine. There is a growing tendency among owners to keep automobiles for several seasons; deterioration arises primarily from lack of care; much of this deterioration is due to ignorance and the consequent failure to prevent the kind of wear that, if not corrected, will lead to heavy expenses for repairs. The contents of the book are as follows: Automobile Types and Parts; Automobile Engines; Gasoline and Substitutes; Gasoline Carburetors; Automobile Ignition; Magnetos and Ignition Testing; Electric Starters; Clutches, Transmissions, and Differentials; Lubrication and Cooling Systems; Automobile Troubles and Noises; it will be found to contain much material of interest and value to automobile owners.



NEW ZINC PLANT IN SHASTA COUNTY, CALIFORNIA, COMMENCES OPERATIONS

The new zinc plant of the Shasta Zinc & Copper Co., at Winthrop, has commenced operation. The smelter has a capacity of 150 tons of ore per day. The net output of zinc oxide will be 30 tons per day. The copper, silver, and gold are saved, too, but they are by-products as compared to the zinc oxide. The zinc is volatilized in the roasters. The copper and silver matte comes from the reverberatory furnace. The zinc is caught in the bag-house as the smoke sifts through 1408 woolen bags. These bags alone cost \$14,000. It was just a year ago that D. C. Jackling and allied capitalists bought the Bully Hill mine and railroad for \$750,000. As much more has been spent since in building the smelter that has just been started. The buildings stand on the site of the Bully Hill smelter that was shut-down in 1909 because zinc in the ore made it impossible to smelt for copper, silver, and gold any longer. Not a semblance of the old works remain. R. L. Beals is general manager; J. H. Rose is superintendent of the smelter; and L. C. Monahan is superintendent of the mines. Seventy-five men will be required to keep the smelter going.

INTERNATIONAL NICKEL COMPANY IS OPERATING AT 20% OF CAPACITY

The report of the International Nickel Co. for the fiscal year ended March 31, 1921, shows a slight decline in earnings as compared with the preceding year. In conjunction with the report the statement of the president, W. A. Bostwick, says in part:

"During the fiscal year covered by this report the business of the company, in common with that of other metal-producing companies, has continued to be much affected by the process of deflation through which the entire world is passing. During the first six months of the present fiscal year a fair volume of business was done, but during the last six months, as the general industrial depression increased and the deflation process progressed, the volume of business was very materially decreased. There were stocks of nickel, as well as secondary or scrap metals still remaining in European markets at the beginning of the year, and these have been only partly liquidated during the year.

"The indications of the last two months in the United States, however, are that stocks in many consumers' hands are gradually becoming exhausted, and the result has been an increased demand, not as yet large in volume, but from an increasingly large number of consumers. During the first half of the fiscal year the company's operations were at approximately 60% capacity. Commencing with the third quarter and, as the volume of business became less, the operations were restricted, until at the conclusion of the year the plants were operated at about 20% capacity, but with sufficient organization retained, and with the plants maintained in such condition as will enable them to increase operations quickly, as the demand for the company's products increases."

The report calls attention to the encouraging market for monel metal and nickel in special-roll forms, and the provision for greater facilities for production. The company is

constructing a plant on Guyan dock, near Huntington, West Virginia, and expects to be operating and producing here before the close of the year. The regular quarterly dividend of 14% was paid on the preferred stock out of earnings, but to conserve cash resources, no dividends were declared on the common. The stockholders now number 16,206.

MOVEMENT OF GOLD AND SILVER

Exports of gold from the United States for the month of May totaled \$1,062,521 as compared with \$383,787 in April and \$7,561,683 in May 1920, while imports were \$58,209,918 as against \$82,236,175 in April and \$15,687,859 in May last year. Gold exports for the eleven months ended with May totaled \$132,764,299 compared with \$481,100,731 during the same months last year while imports amounted to \$602,817,925 against \$123,775,217. Silver exports for May totaled \$2,352,609, compared with \$6,862,130 in May 1920 and imports were \$6,956,077 as against \$8,082,895 in May a year ago. Silver exports for the eleven months period aggregated \$51,112,161 as compared with \$174,621,646 in the same period last year while imports were \$55,805,359 as against \$96,337,935 for the eleven months ended May 1920.

PROPOSED DEPARTMENT OF MINES

Senator Nicholson of Colorado made his debut in the Senate by introducing a bill to create a new cabinet position to be the head of the Department of Mines. The bill provides that the proposed new department shall encourage, protect, and promote the welfare of mining and shall cover the coal and petroleum industries, and all metal-mining activities, including iron and all non-metallie mining and quarrying industries, whether of minerals or of 'rock'. It shall, however, not deal with mining products when they pass from the raw into the manufactured state. The Secretary of Mines, as do other Cabinet officers, would receive a salary of \$12,000 per year.

ARIZONA

Patagonia.—E. E. Bethell, owner of the Mollie Gibson mine which adjoins the Mowry, is making good progress in sinking a new shaft.—The mill of the Bland Mining Co., in the Selaro district, is operating steadily.—At the Consolidated Southern Arizona mine the surface plant at the Sweet shaft is being overhauled in preparation for resumption of operations.—Development work on the Hard-shell properties is to be undertaken at once; diamond-drills will be used for the work.

Pearce.—The orebody on the lease of Emmons and Laymon, on the Rainbow claim of the Commonwealth Extension Mining Co. is now said to be three feet wide. The first shipment, which was less than a carload, brought the lessees about \$500 per ton, showing that the ore ran about \$100 per ton more than expected. Interest is manifested as to whether this vein will open out into the big orebody that the late John Pearce always contended lay in the claims known at the Rainbow, Horn Spoon, Arthur, and Silver Thread.

There was a rumor that the Commonwealth Extension Co. had let its rights lapse, but this is a mistake, as the Commonwealth Extension has all its claims patented and has no indebtedness, according to a local man interested in the company.

ARKANSAS

Yellville.—J. G. Ehman and Brant Lahman have leases on the Happy Jack Lead mine, near Onwatta. Ehman says that they have taken out a lot of high-grade carbonate ore and that the prospect is good.

CALIFORNIA

Angels Camp.—The Jolly Tar Mining Co. has received its first carload of machinery, including a hoist and compressor. The mine was formerly known as the Fezzl. It is situated north of Altaville and is on the same belt as the Ulen, Angels, and Lightner mines, on what is known as the 'East ledge' of the Mother Lode. The company will start sinking as soon as the machinery has all been installed, and is preparing to go down 500 ft. before doing any drifting or cross-cutting.

Benton.—Work is to be resumed immediately on the claims owned by the Lone Star Co. of Goldfield, Nevada. These claims are opened by a 200-ft. shaft. Assays of \$35 have been obtained from the full width of the south drift on the 125-ft. level and a newly found vein on the surface gives returns of \$80 to \$110 from a 4-ft. vein of gold-silver ore.

Calexico.—Discovery of a rich gold vein in the Cocopah Sierra mountains, 40 miles south of the boundary, was announced on June 9 by two American citizens, who arrived here with nuggets for assay. The men are Alex Cisto and Romaldo Ochoa, residents of Calexico. A general stampede of prospectors for the Cocopah Sierras is expected.

Chico.—The El Oro Gold Dredging Co. has purchased 300 acres of land south-east of here, near Butte creek, and will build at once a dredge which will cost \$100,000. Already an auxiliary dredge is working on the land and two good clean-ups are reported. The dredge now in operation has been leased from the Guggenheim interests, who had been working higher up on Butte creek, but had recently shut-down.

Hayden Hill.—High-grade ore is recorded from the Juniper mines; 65,000 tons of ore is said to be blocked-out on the 100- and 200-ft. levels. A flotation plant erected some months ago is working satisfactorily.

Jackson.—Production has started from the Argonaut mine, the ore coming largely from the caved workings. Unwatering of the flooded workings was completed some weeks ago. The adjoining Kennedy mine is not yet unwatered.

Quincy.—Owners of claims in the Onion Valley district are preparing to start work as soon as supplies can be secured over the Quincy-La Porte road. McFarlane Brothers have resumed work. R. C. Kingdon of the Maxine Mining Co. has arranged for the purchase of a larger pump to handle the water in the mine. Cosker Brothers have found 'pay' gravel in the vicinity of Table Rock. Nave and Bradshaw have begun ground-sluicing near Poor Man's creek.

Redding.—Austin Brothers are preparing to ship barium sulphate from a large deposit, near Copper City, that they leased from the Southern Pacific Co. A spur-track and large bins have been erected to be connected with the mine by an aerial tramway a mile long. The deposit is described as being a "whole mountain".

Sonora.—J. E. King is working the Chileno mine at Jackass Hill. Though 'pockets' are found occasionally in the Chileno vein, the ore is of the milling variety, and in the face of the drift where the rich find was made the shoot of

ore is about eight feet wide. King, Edward Thornton, and W. H. Gohring, of Arizona, have acquired ten claims in the Jackass Hill section, in addition to the Chileno mine.

Sutter Creek.—An important improvement made by the management of the Central Eureka company is the raising of the concrete wall of the tailings dam. The dam is over 1000 ft. long. It has a concrete core with a sand filling above and below. The dam is situated a mile west of the Central Eureka mine. The object in raising the concrete wall is to prevent damage to farm land in the valley.

COLORADO

Alma.—Properties closed down and idle since before the War are resuming and greater activity is reported in the Alma-Sacramento district than for many seasons. The Brownlow, Champaign, Dolly Varden, and Moose mines and Mascotte tunnel are among those where work is being resumed. At the Brownlow a new vertical vein has been opened 24 ft. wide, containing both milling and smelting ore. A new mill has been constructed at the Dolly Varden of 200 tons daily capacity; it will shortly be operating. A sacked shipment recently sent out from the Champaign gave returns of better than \$1000 per ton in gold and silver.

At the Hilltop a large tonnage is broken and shipments will be resumed.

Blackhawk.—The Silver Mountain Mining Co. made another rich shipment to the Pueblo smelter last week; the ore was taken out in sinking the shaft. Settlement netted the company approximately \$2000. The new shoot under development at the 260-ft. level, east, is improving as the drift is extended and assays as high as \$500 per ton are reported.

Colorado Springs.—The Golden Cycle Mining & Reduction Co. paid its stockholders on June 10 a dividend of 2c. per share, totaling \$30,000. The total paid to date is \$9,468.50. The mill is handling practically all ore shipped out of the Cripple Creek district, except for a small tonnage of smelting ore shipped direct to Pueblo.

Cripple Creek.—Increase of \$22,571 in May production over that of April is shown in the report of the mills. The tonnage for May was 43,650 tons with an average value of \$10.53 per ton and gross bullion value of \$450,694. Of this tonnage the Golden Cycle M. & R. Co., at Colorado Springs, treated 21,000 tons of \$14 average grade, total \$294,000; Portland G. M. Co., Independence mill, 20,150 tons, \$5.63 per ton, \$113,444; Lincoln M. & R. Co., Ironclad mill, 1500 tons, \$1.50 per ton, \$2250; and smelters, 1000 tons of \$50 grade, \$50,000.

The Vindicator company has increased its working force by putting on a night shift of between 25 and 30 miners and was preparing to deepen the main or north shaft by raising from the 20th level Golden Cycle shaft to connect with the 19th level Vindicator, a 200-ft. raise, when operations temporarily ceased through the washout on the Midland road, preventing coal from reaching the district. Repairs to the road it is estimated will take until the end of the ensuing week. Other properties may also close due to coal shortage.

Edwards.—The East Lake Milling & Mining Co., and the Packard Power & Mining Co., with offices at Toledo, Ohio, have engaged Nels Nelson as superintendent, and both properties are now being developed. The East Lake company owns approximately 175 acres of patented ground. A water-power plant furnishes power for machine-drills and hoist, and a saw-mill furnishes lumber for mines and buildings. Ore is exposed on both groups and shipments will commence soon.

Georgetown.—Operations have been resumed on numerous properties in districts that draw their supplies from this city. Among these are the Anderson group in Argentine, and the Lead Island group in the same district. The Senator

mine near Dumont is the reported scene of an important find, a 12-in. vein of silver-lead ore has been recently opened and ore is being saved for shipment.

IDAHO

Coeur d'Alene.—The New Caledonia Mining Co. has acquired the Magnet group of seven claims in the Wardner district. Development work will begin soon. The Magnet group adjoins the New Caledonia on the south and east and the acquisition of these claims gives the company 20 claims in the heart of the Wardner district almost surrounded by the Bunker Hill territory. Ore is said to assay 40% lead and 5 oz. of silver per ton. The lower tunnel on the Magnet group is in about 750 ft. and at present the work will consist of running a drift on this level.

An agreement has been signed between the Black Bear Mining Co., the Senator Mining Co., and the Coeur d'Alene syndicate, operating in Burke canyon at Black Bear. The Black Bear and Senator are owners of considerable ground, while the Coeur d'Alene syndicate has a bond on the holdings of the Senator Mining Co., as well as what is known as the Flynn group. All claims lie between the old Frisco and Burke canyon and the Morning mine at Mullan. Provision is made in the agreement whereby work may be jointly arranged, with a pro rata division of cost of upkeep and installation. A large area of exceptionally promising ground will be developed.

Under the joint arrangement between the Bunker Hill & Sullivan and Hecla in the opening of Star ground through the Hecla workings, active surface work has commenced. The 8000-ft. cross-cut will be started. For convenient handling of waste, a skip-pocket, with a capacity of several hundred tons, will be built and from this the waste will be hoisted through the Hecla's main shaft. The cross-cut will be driven on the 2000-ft. level, giving great depth under Star ground. Work on the cross-cut will be pushed as rapidly as possible.

Arrangements have been made to ship ore of the Idaho Continental Mining Co. of Port Hill to the Bunker Hill smelter at Kellogg. Approximately 3000 tons of ore and concentrate is on hand. Steadily the Bunker Hill smelter is reaching out to distant districts for ore. As fast as it obtains reasonable freight-rates the smelting company makes new contracts.—Twenty-five to thirty tons of ore is being hauled from the Sidney mine in the Pine Creek district to the Bunker Hill smelter. The ore contains the highest silver content of any ore ever shipped out of Pine creek, averaging 50 ounces per ton. The property is being worked by W. W. Papesch of Kellogg and associates, who have a lease on the mine.—E. J. Davey, president of the West Hunter Mining Co. in the Couer d'Alene, has let a contract under which work is to be resumed at once.

The Bunker Hill company is applying 'gunite' as surfacing for the new south mill being erected on the site of the old mill which burned last summer. In addition to affording fire protection, gunite adds to the rigidity and durability of the construction. Gunite is being applied both inside and outside of the storage-bins.

Mackay.—A deposit that is thought to contain uranium minerals has been discovered 50 miles north of here. Before analysis had definitely established the character of the mineral, the entire district was located.—John J. Howell, of the Mount Sullivan Mining Co., states that the last shipment of 35 tons netted the company \$900.

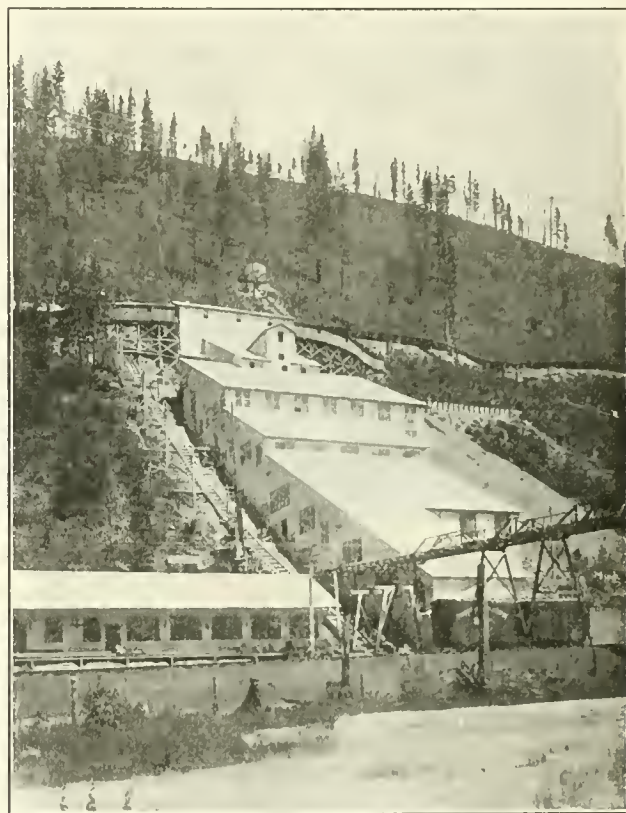
Sandpoint.—J. E. Coleman and D. D. Ward have found an 8-in. vein of silver ore assaying 1500 oz. per ton. The vein was found after driving 32 ft. beyond a fault which cut it off.

Talache.—A concentrating mill on the property of the Armstead mine, on Pend Oreille lake, will be erected this

summer, according to H. H. Armstead, manager and president. Twenty-five men are now employed. The plant will have a capacity of 150 tons daily. The quantity of ore blocked-out is ample to supply the mill. Its average value is \$20 per ton, mainly silver. The quantity is said to be sufficient to retire the cost of the mine, the cost of all development, and the cost of the mill to be built, and leave a profit on all of the money spent. A motor highway from the mine to Sagle, on the Northern Pacific, is being built.

KANSAS

Galena.—The Eagle-Picher Lead Co. has agreed to come into the Galena mining district with such leases as are now signed and start development at once. The first action to be taken is the drainage of the land and the starting of a number of drill-rigs. The grant of acreage to the company



The National Mill at Mullan, Idaho

by several of the land-owners includes some of the pioneer producers of the district. This is considered by mining men as an important development in the movement to induce capital to invest in the Galena district.

MICHIGAN

Houghton.—The Copper Range mines are still experiencing a considerable labor turnover, the most marked in years despite the general depression in the district. During the month of May the net gain at Champion was only 28 men, while the gain for both Baltic and Trimountain was only 12. The men giving up their jobs are going either to the farms or leaving the district. The three mines have only about half of their normal 1915-'16 force. The total, in round numbers, is 1300; of these 600 are employed at Champion, 400 at Baltic, and 300 at Trimountain. While good underground men continue to be taken on at the mines, a reduction in the mill forces has been made possible through increasing the amount of 'rock' stamped per shift. The three mines are shipping a total of 3000 tons of 'rock' daily, of which Champion is furnishing 1900. This is an increase of

100 tons for Champlon within the last few weeks. Battle continues to ship 700 tons daily and Trimountain 400. The yield shows little or no change.

The third cut in wages and salaries, made effective at the Copper Range mines and mills on June 1, brought the total reduction since the depression set in to 32%. The latest cut of 10% makes the wages of the miners \$3.15 per day and trimmers and other underground labor \$2.70. Other wages have been reduced in proportion. Little or no complaint was occasioned by the cut, the employees accepting it in the spirit that 'half a loaf is better than none'. Quincy already has in effect a 32% wage and salary reduction, while the total Calumet & Hecla cut is 35%. Wolverine and Mohawk reductions have kept pace with those of Calumet & Hecla, so all the operating mines in the district are now about on the same schedule of wages.

Calumet & Hecla continues to receive timber shipments for underground purposes. The timber is being stored near the mines for use when operations are resumed. It is being delivered by various contractors. The company continues to operate six of its furnaces in the smelting plant at Hubbell.

MISSOURI

Joplin.—In spite of the present dullness there are a number of mines in the Tri-State field making particularly good recoveries just at this time. Among these is the Vinegar Hill Barr mine, situated north of Picher. Across the road to the west is the Commerce Mining & Royalty Co., which is making good production from the north shaft of its Webber mine, where the 'dirt' is reported to be running better than 8%. The U. S. Smelting Co.'s Ritz mine also is a big producer of lead just now, something like 100 tons per week being made. This mine is now being operated by S. H. Davis and W. H. Smith, of Platteville, Wisconsin, and several other associates.

MONTANA

Basin.—It is reported that operations will be resumed at the Jib mine.

Butte.—The East Butte smelter continues to produce at the rate of about 1,000,000 lb. of copper per month. About half of this comes from the Davis-Daly company. The East Butte Co. has resorted to churn-drilling in an effort to determine the thickness of quicksands in a portion of the property through which it is planned to raise to the surface. The new shaft will lessen materially the distance through which it will be necessary to cross-cut before reaching the orebodies.

The Anaconda Copper Mining Co. has contracted with the Pacific Gas & Electric Co., of San Francisco, for the delivery of 10,000,000 lb. of copper wire. This order is said to be the largest ever placed and will be supplied from the Anaconda company's wire-drawing plant at Great Falls. The wire will be used in the construction of a long transmission line from the power company's new hydro-electric power-plant to the distribution system on the Coast.

De Borgia.—The Silver Rock Mining Co. has been financed to the extent of \$100,000 for the development of its property near here. According to J. F. Brown, new machinery will be delivered within 60 days.

Elkhorn.—On the 300-ft. level of the Boston & Montana Development Co.'s mine, the new cross-cut is nearing the Elkhorn vein. Equipping of the 700-ton mill is progressing as rapidly as supplies are delivered.

Elliston.—The Evening Star Development Co. is shipping from the Big Dick mine.

Libby.—W. D. Dilley has started work at the Victor Empire mine. He is backed by Colorado capitalists. The present work consists of extending the main tunnel, which is now 1338 ft. long.

Marysville. The St. Louis Mining & Milling Co. is preparing to re-open the old Drumlunnon mine that is credited with a production of \$20,000,000 in gold.

Neihart. It is said that the Silver Dyke property in which there is a large deposit of silver-bearing rock is to be thoroughly developed in anticipation of finding a large body of low-grade ore.

Superior.—It is reported that Gildersleeve Brothers are developing good ore in an adit following a 20-ft. vein. In addition to 9% of nickel, the ore contains gold, silver, and copper.

Troy.—Work is to be resumed by the Consolidated Silver-Lead Mining Co., a consolidation of the Silver Tip, J. P. Lead, and Troy companies. There is a strong vein already prospected by 2400 ft. of adits. It is hoped to find good shoots of lead-silver ore.

NEVADA

Ely.—A statement issued to stockholders by the Copper-mines company says: "Pursuant to notice accompanying our circular letter of April 7, the special stockholders' meeting was held on May 3, and the increase in capitalization was ordered. This makes full provision for conversion of the Consolidated general mortgage bonds and all bonds issued will have conversion privilege at par for the stock and par for the bonds. Considerable sums have been borrowed during the past year to meet necessary expenses and pay interest on bonds now outstanding. It is estimated that to fund this floating indebtedness and carry the properties to July 1, 1922, about \$600,000 will be required. There is every reason to believe that long before that time conditions will have so improved that the larger financing can be put through and construction of the new plant will be well under way."

Eureka.—Eureka-Hamilton Mines Co. reports that the winze in the Pocatillo tunnel has reached a depth of 60 ft., and that the value of the ore averages \$41 per ton. A raise in the same tunnel about 400 ft. from the portal has opened an 8-ft. vein from which assays of from \$35 to \$75 have been secured.

Freiburg.—F. G. Brassell, a Los Angeles broker, has undertaken to finance the Combination Divide for development of 26 claims owned or held under lease and bond at Freiburg, in the north-western corner of Lincoln county, 80 miles from Caliente, the shipping point. The claims were examined recently by Brassell and V. Pistonatti, a mining engineer. They have been opened by several shafts, the deepest of which is 185 ft. The main vein is 12 ft. wide and at a depth of 50 ft. an assay of 12 oz. silver, 15% lead, and 12% copper was obtained from the full width of the vein. There is several hundred tons of ore in the dumps, including 125 sacks of high-grade material. Of the group, 19 of the claims have been worked for 15 years by Charles Briscoe of Pioche, who during this period made many shipments through Caliente. The new owners say they plan to equip the property and build a mill.—The Olympus Mining & Milling Co. has started work on claims formerly owned by the late Judge C. C. Goodwin of Salt Lake City and this company plans to develop the claims and erect a concentrator for the treatment of 2000 tons of \$75 lead-silver ore in dumps. Another company, of which Briscoe is the manager, plans to build a small smelter.

Goldfield.—Simpson, McIntee, and Grim, lessees on the Combination mine of the Consolidated, have shipped a 50-ton carload of \$150 ore, according to samples taken by the Consolidated management. These lessees are now breaking \$20 to \$30 ore and will soon ship a carload of this grade. Other lessees on the Consolidated have five carloads of ore ready for shipment when the Tonopah mills re-open. The Deep Mines shaft is nearing the 550-ft. point. The Kewanas

is drifting north and south on the St. Ives vein in work being done through the Merger shaft. Assays of \$10 to \$17 are being obtained in the north drift.

The Goldfield Development Co. has levied assessment No. 3, at the rate of 1c. per share, payable immediately and delinquent July 9.

Silverhorn.—The adit being driven to get under the high-grade orebody found in the Huson shaft on the Silver Dale mine has entered the vein. The adit has not yet reached the high-grade streak, but assays of \$10 to \$12 per ton are better than was expected in the lean portion of the vein.

—In developing the body of milling ore found in his lease on the Silver Dale, George Z. Smith has opened a two-foot streak that averages \$50 per ton.—In prospecting the surface of the Nevada Silver Horn, J. Nelson Nevius found float that shows three different chlorides, argentite, and native silver, and he believes he has found its source. George Smith continues to sack high-grade from the rich streak on his Silver Horn No. 2 lease, and from assays of grab-samples he estimates the average values at this time to be \$200 per ton.

Tonopah.—An important meeting of the hoisting engineers, which it had been hoped would end the Tonopah strike, resulted in the engineers agreeing to remain on strike and it is generally supposed that this will result in the detachment of 50 State police now in Reno being sent here. There have been a number of more or less serious clashes between the strikers and strike-breakers and a number of the oldest employees of the companies, including several bosses, have left Tonopah. After the housing facilities for the strike-breakers had been exhausted, the importation of strike-breakers was stopped for a short time, but this has been resumed. Eastern officials of the Tonopah Mining Co. have given orders to shut-down, but the Belmont and Tonopah Extension are hauling houses from Divide and are building on a substantial scale that indicates they are determined to keep the mines producing. It is expected that the Tonopah Extension mill will be running in a few days. The Belmont is preparing houses for 150 men as the eighth week of the strike draws to a close. The men who have been employed continually by the West End and other companies are giving financial aid to the strikers on the supposition that if the strike is lost their wages will be reduced. However, it is said the West End has no intention of cutting wages.

TEXAS

Austin.—It is reported that samples of salts recently sent from western Texas to the laboratories of the U. S. Geological Survey at Washington contain percentages of potash which suggest at least the richness of the potash deposits of Alsace and Germany. The samples were obtained from two borings about 80 miles apart, sunk by oil companies in the Red Beds region of Texas, where salt beds, red shales, gypsum, and other materials are associated in strata of nearly the same geologic age and general character as the potash-bearing beds of western Europe. The thickness of the potash-bearing beds in Texas represented by these samples is unknown, however, and the questions remain to be determined whether the deposit is thick enough to furnish potash in great amount, or whether it is of scientific interest only.

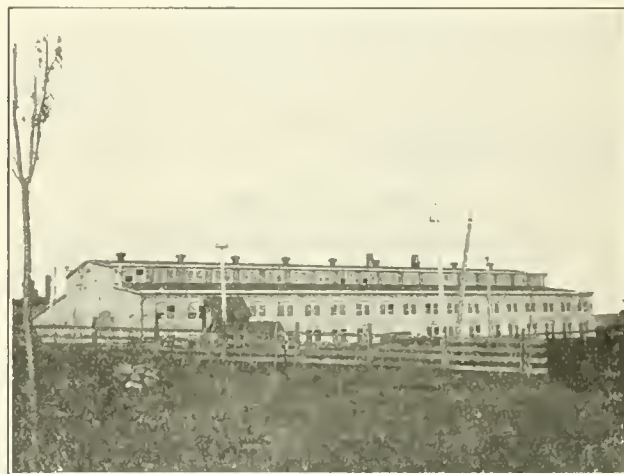
UTAH

Alta.—After a long winter, during which more snow has fallen than for many years, the mines in this camp are re-suming activity. The Little Cottonwood Transportation Co.'s railroad has been cleared of snow, and the equipment overhauled. Shipments of ore have been started from the South Hecla property. G. H. Watson, manager, states that he expects to ship between 6000 and 7000 tons of ore during the summer. The ore-bins, and all available storing areas,

are full of ore which has been mined during the past few months.—The tramway at the Michigan-Utah has been repaired and shipments will be made this summer.

Eureka.—The Apex-Standard Mining Co. has secured control of the Tintic-Zenith and Tintic-Eastern properties, according to Louis Merriman, manager of the Apex Standard. At the same time, announcement was made that the control of the Tintic Union property has passed to the Apex Standard, but it is not certain that the Tintic Union will be merged with the other three properties. The management is pleased with recent development work on the 900-ft. level of the Apex Standard, and it is planned to put on a second shift. Walter Fitch, president of the Chief Consolidated, has acquired a substantial interest in the Apex Standard.

Shipments of ore from this district for the week ending June 4 totaled 119 cars, as compared with 123 cars for the preceding week. The Tintic Standard shipped 44 cars; Chief



Electrolytic Refinery at Hubbell, Michigan

Consolidated, 38; Eagle & Blue Bell, 7; Iron Blossom, 6; Iron King, 6; Dragon, 6; Victoria, 4; Gemini, 2; Alaska, 2; Colorado, 2; Swansea, 2.

During May, the shaft at the Independence Mining Co. was sunk a total of 60 ft., with but one shift on the work. The company is paying \$23 per foot to the contractors engaged on this work, 25% of which is payable in stock of the company.

Park City.—The controversy between the American Smelting & Refining Co. and the Silver King Coalition Mines Co., regarding increase in smelting rates, has been adjusted entirely to the satisfaction of both corporations. W. Mont Ferry, managing director of the Silver King Coalition, states that shipments have been resumed and all probability of any litigation entirely precluded. George W. Lambourne, president and general manager of the Daly-West Mining Co., reports that the differences between his company and the A. S. & R. have not been adjusted. C. W. Whitley, vice-president of the A. S. & R., has been in Utah and had several conferences with officials of both mining companies. It is stated that the smelting contract held by the Silver King Coalition is one of the best smelting contracts, from the producer's standpoint, now in force.

Ore shipments from this district for the week ending June 4 totaled 1097 tons, of which the Judge allied companies shipped 611; Ontario, 268; Silver King Coalition, 218. Shipments the previous week totaled 993 tons.

Salt Lake City.—Announcement was made on June 5 of the reduction from \$22 to \$16.50 per ton in freight-rates on bullion from Utah smelting points to the Atlantic seaboard. The reduction means much to local mining operators. In reality it is a return to the rate effective up to August 26,

1920. On that date, the \$22 rate, which was a 33 1/3% increase, became effective, and local smelting companies immediately deducted approximately one cent per ounce on silver and one-quarter cent per pound on lead contents to cover the additional freight on bullion. It is the opinion of local operators that this charge will now be cancelled by the smelting companies. The announcement of the reduction in freight on bullion, coupled with a price of 5 cents per pound for lead, has created a more cheerful feeling.

The directors of the Utah Copper Co. declared a dividend of 50 cents per share on June 9. This will call for the distribution of \$812,245. On March 31 the company paid a dividend of \$1 per share, and during 1920, distributions were at the rate of \$1.50 per quarter. The grand total of dividend disbursements to date is \$113,916,397.50.

ALBERTA

Peace River.—A discovery of gold is reported to have been made in a creek that empties into the Cadotte river. The Cadotte is a tributary of the Peace river, into which it flows at a point about 35 miles below the town of Peace River. A little excavating and panning seems to have demonstrated the value of the discovery and a large number of claims have been staked.

BRITISH COLUMBIA

Anyox.—The Granby Consolidated Mining, Smelting & Power Co.'s annual report has just been issued, and shows a deficit of \$687,011 for the year 1920. This compares with a deficit of \$984,409 for 1919, but in the latter year dividends amounting to \$1,312,537 were disbursed, while last year no dividends were paid. The company produced 25,081,361 lb. of copper during the year at an average cost of 15.94c., and sold 19,464,796 lb. at an average of 17.85c. The company also produced 9481 oz. of gold and 1,054,206 oz. of silver. The great bulk of the silver was obtained from ore purchased from the Dolly Varden mine, an ore that was utilized for fluxing the company's Hidden Creek ores. The cost of the production of copper has been markedly reduced during the present year, and during the month of March averaged only 12.44c. This reduction has been made possible by a reduction in the wage-scale of the workers, combined with more efficient work.

Nelson.—The directors of the Standard Silver-Lead Mining Co. have announced that, subject to ratification by the shareholders at a general meeting to be held on June 20, the Standard mine has been sold for \$75,000, of which \$25,000 is to be cash, and the balance in two equal installments at one and two years, respectively. Tribute of 20% is to be paid on all ore shipped, the same to apply toward the purchase price. The identity of the purchasers is being withheld. As the directors hold or control the majority of the stock of the company, it is unlikely that the sale will not be ratified. It is understood that the company, which after the completion of the purchase will have more than \$500,000 in the treasury, will continue to search for another mine to develop and work. The Standard has paid more than two and a half millions in dividends.

Stewart.—Despite the advice of the settlement of the strike at the Premier mine that has been circulated throughout British Columbia, the settlement has not been made. Recently the men suggested that the company should meet them half way, and reduce the cut by half. This Dale Pitt, the manager, refused. The men then held a meeting to decide if the proposed cut in the wage-scale should be accepted, and by a vote of 121 to 32 it was decided that it should not.

MEXICO

Coahuila.—Preparations are being made for resuming mining in the old Sierra Mojado district. The Compania

Minera Asarco, through its representative, Walter H. Gates, recently filed upon a group of sixty-seven claims, in that district. They will be developed under the name of El Panama. The fact that the Mexican government is now constructing an extension of the Cuatro Ciénegas branch of the National Railways of Mexico to Sierra Mojado lends additional importance to the district as this road will give a rail transportation outlet to the east.

Monterrey.—Notwithstanding the general unsatisfactory condition of the mining industry, the present year promises to show an output of metals in Mexico that will compare favorably with any previous year, according to Antonio Villarreal, secretary of industry and commerce of the Mexican government. In a recent public statement General Villarreal says there are approximately 20,000 mines now in operation in this country. In a great many cases these properties are producing a nominal quantity of ore, but it is also true that some of the larger mines are working to full capacity. With an improvement in the prices of metals and a betterment of transportation facilities there should be unprecedented activity in Mexican mining.

Pachuca.—Operation of the Santa Gertrudis mill resulted in an estimated loss for the first quarter of 1920 of £4677. The value of bullion produced was £53,733, being derived from 32,801 tons of ore from the Santa Gertrudis mine, and 74,948 tons from the El Bordo mines. The price of silver was taken at \$0.559 per fine ounce, as compared with \$0.68 for the preceding quarterly period.

ONTARIO

Cobalt.—The annual report of the Mining Corporation of Canada for 1920 shows that production amounted to 1,644,018 oz. of silver, being an increase of 433,365 oz. over the preceding year. Owing to the decreased price of silver, profits showed a considerable decrease, being \$579,569, as compared with \$908,748 in 1919. An encouraging feature is the increase in the ore-reserves, which were estimated at 2,181,000 oz., as compared with 1,307,220. The Buffalo mine has an estimated ore-reserve of 1,350,060 oz. During the year the Corporation, in view of the ultimate exhaustion of its Cobalt holdings, investigated a large number of properties elsewhere, of which 132 were in Canada and 56 in Ontario. Scott Turner, the company's consulting engineer, states that Canada will continue to be the principal scene of the company's activities.

Porcupine.—The Hollinger Reserve, lying west of the Hollinger Consolidated, has been bought by a syndicate headed by E. A. Osler & Co., of Toronto, stated to include several American financiers. A new company, to be known as the McEnaney Gold Mines, will be formed. The early re-opening of the property is planned. A high-grade vein system has been opened at considerable length on the 300-ft. level.—C. H. Poirier, of New York, has concluded his examination of the Goldale properties, formerly owned by the Bewick-Moreing interests, and is arranging for the commencement of active mining operations.

YUKON

White Horse.—Hundreds of tons of supplies, building material, and mining machinery are accumulating here, for shipment to Mayo. The Yukon Gold Mining Co. and the White Pass Railway are building permanent wharves at Mayo Landing, to accommodate this and subsequent shipments. The Wheaton River district is likely to attract attention this year, and already the Tally Ho mine has been reopened. This district was discovered in 1893, and it contains lodes that carry free gold, telluride of gold, silver, antimonial silver, and silver-lead ores, but little work has been done. It is excellently situated, being only 30 miles from here, and three or four from the White Pass railway.

PERSONAL

The Editor invites members of the profession to send particulars of their work and appointments. The information is interesting to our readers.

Wilbur H. Grant is in Mexico.

J. B. Hastings is in San Francisco.

W. A. Clark is here from New York.

S. H. Brady is at the Sheba mine, at Imlay, Nevada.

C. B. Lakenan leaves San Francisco for Alaska on July 1.

Forest Rutherford is in Canada on mine-examination work.

L. R. Budrow, of Douglas, Arizona, was in San Francisco last week.

John McCabe has been appointed assayer at the San Francisco Mint.

W. J. McCormick is now with the U. S. Graphite Co., at Sonora, Mexico.

H. S. Reed Jr. has moved from Shawmut, California, to Millers, Nevada.

Ezra B. Rider, recently at Globe, Arizona, is at Fitch Boy, in Quebec, Canada.

H. C. Hopkins, recently of Tyrone, New Mexico, is at Lead, South Dakota.

L. C. Graton, of Cambridge, Massachusetts, is at Calumet, Michigan, for the summer.

W. W. Wishon is in San Francisco, on his return from Cariboo, British Columbia.

John Tait Milliken has moved from Ingot, California, to Colorado Springs, Colorado.

John Gillic, of the Anaconda company, is expected in Butte on his return from New York.

A. H. Burroughs Jr. has been elected managing director of the Armstead Mines company.

Walter Harvey Weed is examining the Virginia Louise mine at Pioche, Nevada, for the owners.

Ralph Stokes, assistant general manager for the De Beers Consolidated, is in London on a holiday.

W. H. Corbould, manager for the Mount Elliott Copper Co., in Queensland, is expected in London.

Charles F. Sturtevant, of the firm Sturtevant & Bergh, at Salt Lake City, Utah, is at Mayer, Arizona.

Walter Harris, metallurgist to the Old Dominion company, at Globe, Arizona, is now residing at Berkeley.

C. C. Brayton has returned to San Francisco after a visit to the copper districts of Arizona and Montana.

Hugh R. Van Wagenen passed through San Francisco on his return to Copper Mountain, British Columbia.

Walter Fitch Jr., mining contractor of Eureka, Utah, has returned home after a trip to southern California.

A. G. Cadogan, of Berkeley, California, is now with the Potrero Mining Co., at Mocoielo, in Sinaloa, Mexico.

E. J. Franklin, mechanical engineer for the Ray Consolidated Copper Co., at Hayden, is at Salt Lake City.

R. W. French, who returned recently from Chontales, in Nicaragua, is prospecting in Trinity county, California.

Errol MacBoyle has left for Alamo, Baja California, Mexico, to start the re-opening of gold-mining properties.

Joseph Clendenin has been elected a director of the Chile Copper Co., succeeding William C. Potter, who has resigned.

W. A. Wilson, mining engineer of Salt Lake City, has been visiting mines in the Wood River district at Ketchum, Idaho.

Henry H. Armstead, president of the Armstead Mines, Inc., is at Talache, Idaho, where he will remain for one month.

Henry M. Adkinson, of Salt Lake City, attended the cele-

bration commemorating the thirtieth anniversary of the founding of the University of Chicago, of which institution he is a graduate.

T. Kawaseki, professor of mining at the Imperial Technical Institute at Port Arthur, South Manchuria, has been visiting mining districts in Utah.

H. O. Graham, chief engineer for the Indiana Public Utilities Commission, has been elected president of the American Association of Engineers.

Cornelius F. Kelley, president of the Anaconda Copper Mining Co., is expected at Butte on his way to his summer retreat on Swan Lake at the end of June.

Frederick Laist, manager of the Anaconda Reduction Works, delivered the Commencement address before the Colorado School of Mines on June 19 and received an honorary degree.

Arthur S. Dwight sailed on June 16 from New York as a representative of the American engineering societies to attend the meeting of the Institution of Civil Engineers on the occasion of the presentation of the John Fritz medal to Sir Robert Hadfield.

Burr McWhirt has resigned as valuation engineer in the Oil and Gas Section of the Income Tax Unit at Washington, to become associated with J. C. Dick, who recently opened offices in Salt Lake City and Los Angeles. The firm will specialize in technical questions involving mining, oil, and gas properties, particularly as to matters pertaining to Federal income-tax laws.

Obituary

Frank D. Baker died at Denver on April 29. For a large part of the twenty years during which he was chief engineer of the Colorado department of the American Smelting & Refining Co., he was responsible for, or in close touch with, a great deal of metallurgical plant-construction in the State. Among his inventions may be mentioned a cooler for temperature reduction of calcined materials. He graduated from the University of Illinois in 1888, and was a member of a number of technical societies. He is survived by a widow and five children.

James A. Callahan, for a number of years a dominant figure in northern Idaho, died on June 12 at Wallace. He held much of the stock of the Callahan Zinc-Lead company, in the Coeur d'Alene region, formerly the Consolidated Interstate-Callahan, a property that paid over \$3,000,000 in dividends during one of the years when War melons were being distributed. He recently suffered a heavy financial loss through the forgeries of two Spokane business men; the strain in connection with this case is said to have brought about the illness that led to his death.

P. George Gow was killed in an automobile accident near his ranch at Modesto, California, on June 8. He was born in Scotland 55 years ago. When 18 years old he came to this country, starting in Wyoming. In 1893, he had charge of the exhibit of cyanide at the Columbian Exposition, being at that time connected with the Cassel company, of Glasgow, and taking a prominent part in the introduction of cyanidation in the West through the medium of the Gold & Silver Extraction Co. In 1896 he came to California to manage the Jumpers mine in Tuolumne county. In 1905 and 1906 he acquired a part-ownership in the Dolores mine, in Mexico, by the sale of which he gained a competence for life. For 25 years he lived at Berkeley, where he leaves a widow and three sons. George Gow was well known in Colorado and California as a capable mining engineer and a good man of business. He leaves many friends who grieve his untimely end.

THE METAL MARKET



METAL PRICES

San Francisco June 14

Aluminum dust, cents per pound	75
Antimony, cents per pound	6.75
Copper electrolytic, cents per pound	13.00—13.50
Lead, 94% test, cents per pound	4.75—5.75
Platinum, pure, per ounce	\$75
Platinum, 10% iridium, per ounce	\$105
Quick-silver, per flask of 75 lb.	\$50
Silver, cents per pound	6.50
Zinc dust, cents per pound	9.00—9.50

EASTERN METAL MARKET

(By wire from New York)

June 14—Copper is inactive but easy. Lead is quiet and steady. Zinc is dull and slightly lower.

SILVER

Below are given official or ticker quotations for silver in the open market as distinguished from the fixed price obtainable for metal produced, smelted, and refined exclusively within the United States. Under the terms of the Pittman Act such silver will be purchased by the United States Mint at \$1 per ounce, subject to certain small charges which vary slightly but amount to approximately three-eighths of one cent. The equivalent of dollar silver (1000 fine) in British currency is 40.05 pence per ounce (925 fine), calculated at the normal rate of exchange.

Date	New York	London	Average week ending	
	cents	pence	Cents	Pence
June 7	58.12	34.87	May 2	60.68
" 8	58.12	34.87	" 9	61.58
" 9	57.37	35.00	" 16	60.41
" 10	58.50	35.50	" 23	58.93
" 11	59.12	35.75	" 30	58.15
" 12 Sunday			June 6	57.68
" 13	59.12	35.75	" 13	58.39

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.	101.12	132.77	65.95	July	106.30	92.04	1021
Feb.	101.12	131.27	59.55	Aug.	111.35	96.23	....
Mch.	101.12	125.70	56.08	Sept.	113.92	93.66	....
Apr.	101.12	119.50	59.33	Oct.	119.10	83.48	....
May	107.23	102.89	59.90	Nov.	127.57	77.73	....
June	110.50	90.84	....	Dec.	131.92	64.78	....

COPPER

Prices of electrolytic, in cents per pound.

Date		Average week ending	
June 7	13.00	May 2	12.37
" 8	13.00	" 9	12.46
" 9	12.87	" 16	12.50
" 10	12.87	" 23	12.89
" 11	12.87	" 30	13.25
" 12 Sunday		June 6	13.08
" 13	12.87	" 13	12.91

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.	20.43	19.25	12.94	July	20.82	19.00	....
Feb.	17.34	19.05	12.84	Aug.	22.51	19.00	....
Mch.	15.05	18.49	12.20	Sept.	22.10	18.75	....
Apr.	15.23	19.23	12.50	Oct.	21.66	16.53	....
May	15.91	19.05	12.74	Nov.	20.45	14.63	....
June	17.53	19.00	....	Dec.	18.55	13.18	....

LEAD

Lead is quoted in cents per pound, New York delivery.

Date		Average week ending	
June 7	4.75	May 2	4.45
" 8	4.75	" 9	4.85
" 9	4.75	" 16	5.14
" 10	4.75	" 23	5.10
" 11	4.75	" 30	5.02
" 12 Sunday		June 6	4.90
" 13	4.75	" 13	4.75

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.	5.60	8.65	4.96	July	5.53	8.63	....
Feb.	5.13	8.88	4.54	Aug.	5.78	9.03	....
Mch.	5.24	9.22	4.06	Sept.	6.02	8.08	....
Apr.	5.05	8.78	4.32	Oct.	6.40	7.28	....
May	5.04	8.55	5.01	Nov.	6.76	6.37	....
June	5.32	8.43	....	Dec.	7.12	4.76	....

TIN

Prices in New York, in cents per pound.

	1919	1920	1921		1919	1920	1921
Jan.	71.50	62.74	35.94	July	70.11	49.29	....
Feb.	72.44	59.87	32.16	Aug.	62.20	47.60	....
Mch.	72.50	61.92	28.87	Sept.	55.79	44.43	....
Apr.	72.50	62.17	30.36	Oct.	54.82	40.47	....
May	72.50	54.99	32.50	Nov.	54.17	36.97	....
June	71.83	48.33	....	Dec.	54.94	34.12	....

ZINC

Zinc is quoted as spelter, standard Western brands, New York delivery, in cents per pound.

Date		Average week ending	
June 7	5.05	May 2	5.49
" 8	5.00	" 9	5.45
" 9	5.00	" 16	5.41
" 10	4.95	" 23	5.35
" 11	4.95	" 30	5.25
" 12 Sunday		June 6	5.17
" 13	4.95	" 13	4.98

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.	7.44	9.56	5.86	July	7.78	8.18	....
Feb.	6.71	9.15	5.34	Aug.	7.81	8.31	....
Mch.	6.53	8.93	5.19	Sept.	7.57	7.84	....
Apr.	6.49	8.76	5.33	Oct.	7.82	7.50	....
May	6.43	8.07	5.37	Nov.	8.12	6.78	....
June	6.91	7.92	....	Dec.	8.69	6.03	....

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, according to quantity. Prices, in dollars per flask of 75 pounds.

Date			
May 17	50.00	May 31	50.00
June 24	50.00	June 7	50.00
		June 14	50.00

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.	103.75	89.00	50.00	July	100.00	88.00	....
Feb.	90.00	81.00	48.75	Aug.	103.00	85.00	....
Mch.	72.80	87.00	45.88	Sept.	102.60	75.00	....
Apr.	73.12	100.00	46.00	Oct.	80.00	71.00	....
May	84.80	87.00	50.00	Nov.	78.00	56.00	....
June	64.40	85.00	....	Dec.	95.00	52.50	....

ELECTRICITY AND PUBLIC UTILITIES

"From the point of view of industry," says a report by Edward N. Hurley to the Senate Committee on Judiciary, "electrical power has ceased to be a local problem, it has become an interstate problem. Already there are steam and hydro-electric plants built in large units which provide service over a radius of 100 miles or more. It is certain that the larger the generating capacity of an electrical plant, the greater the economy. Small units serving small communities are rapidly becoming obsolete, and great stations must be built to serve the nation."

"If the proper encouragement is given, the electric light and power industry will spring forward in the next decade faster even than in the past ten years. The result unquestionably will be the lowering of the cost of living and the conservation of national resources with consequent benefit to the whole population. Upon the development and application of electrical energy, more than upon any other thing, are dependent both the speeding up of production and the conservation of our natural resources."

"The almost unlimited water-power of the nation cannot be harnessed for the benefit of the public without enormous capital investment. Officials of public-utility corporations must gain the public's appreciation and confidence if this tremendous project is to be successful. Today there are 1,450,000 American citizens who have put their savings into the securities of the electric light and power industry, and there are millions more who may be listed as indirect investors through the banks and insurance companies. They already have invested five billion dollars, and billions more must be forthcoming if the complete job is to be accomplished."

"The public will invest after it has been taken into confidence by the heads of the electrical industry and made to understand and appreciate the work of utility corporations. It must be realized that confidence in public utility securities cannot be had by constant, unjust criticism, and that the financial standing of a well managed street-railway, gas, or electric-lighting plant is as vital to the life and development of a community as its banks, and therefore should be protected against unfair attacks so that customers and the investing public will have confidence in the properties, resulting in a desire to purchase utility securities when offered."

"In some sections of the country where communities are not receiving proper services of local lighting and transportation companies, the people are advocating municipal ownership. If mismanagement or disregard of the public be proved, then drastic action is warranted, but municipal or government ownership will not give the relief desired."

Hurley admitted having been "at one time sympathetic toward government ownership," but after a number of years in government service he "is convinced that no community can receive the industrial service to which it is entitled under municipal or government management. The cause for this lies in the human element, and the personal efficiency of men in such enterprises is never higher than 50%. From the point of view of 'service to the public,' government operation in industrial service is a flat failure."

"When public utilities realize what high-grade service means and what effect such a service has upon the public, then the question of municipal or government ownership will gradually drop into the background and the public recognition of the difficulties and the need for encouragement and liberality will quickly aid in the solution of this national problem."

MONEY AND EXCHANGE

Foreign quotations on June 14 are as follows:	
Sterling, dollars:	Cable 3.76 3/4
	Demand 3.77 1/2
Francs, cents:	Cable 8.10
	Demand 8.12
Lire, cents:	Demand 5.20
Marks, cents:	..... 1.52

Eastern Metal Market

New York, June 8.

The markets continue inactive and devoid of features. The price tendency in all of the metals is downward.

Copper demand, particularly foreign, has fallen off, due largely to the fall in exchange.

The tin market has declined for the same reason but buying has been a little more active.

Demand for lead is light and prices have been reduced.

There is no life to the zinc market and values are lower.

IRON AND STEEL

The statistics of both pig-iron and steel ingot production in May bear out the estimate generally accepted in that month that steel works were averaging a 30% operation. In both cases the figures are so close to those for April as to suggest an industry fairly dragging on the bottom, with little in sight pointing to any appreciable change.

In the 31 days of May pig-iron production was 1,221,221 tons, or 39,394 tons per day, against 1,193,041 tons in the 30 days of April, or 39,768 tons per day. For a smaller output in a 31-day month nearly 13 years must be retraced, July 1908 showing 1,218,129 tons.

Thirteen furnaces were blown out in May and seven were blown in—a net loss of six. The 90 furnaces active as June came in had a daily capacity of 38,080 tons per day against 38,505 tons for 96 furnaces on May 1. Current production is at a yearly rate of 14,000,000 tons, whereas output in 1920 was 36,925,987 tons.

The American Iron and Steel Institute's steel statistics, just issued, show that the May output of ingots was 1,503,206 tons, or about 4% more than that of April, with 1,441,537 tons. At the daily rate for May annual production would be 17,980,465 tons. Output in both 1917 and 1918 exceeded 43,000,000 tons.

The volume of current business has if anything fallen off in the week. Definitely lower prices have been established in wire products, and in black and blue annealed sheets. Concessions are made in other finished steel lines, but owing to paucity of the orders price shading is not general.

COPPER

The market has not regained the activity which characterized the early and middle parts of May. There is very little pessimism, however, for it is claimed that the metal is daily going into consumption here and abroad, that stocks are gradually being depleted, and that production is down to a minimum. It is conservatively figured that consumption is 60% of what it was before the War but that production is not over 40,000,000 lb. per month and getting less with most of the mines closed. Because of the fall in exchange in the last week or two, buying for export has declined and there has been no spurt in domestic demand. As a result a few buyers have indicated a willingness to sell at concessions so that electrolytic copper is quiet at 13.25c., delivered, or 13c., New York, for June, with July at 13.50c. and third quarter at 13.75c. Early delivery from most large producers is held firmly at 13.50c., delivered, with some unwilling to quote earlier than July. Lake copper is quiet and nominal at 13 to 13.25c., delivered.

TIN

The drop in sterling has been the dominant factor in this market the past week. As a result largely of this, values here and in London have dropped appreciably, those here having declined nearly 2c. per pound and those in London from £8 to £12 per ton in the week. Spot Straits tin yesterday was quoted at 29c., New York, while in London spot standard yesterday was reported as £165 15s., future stand-

ard as £167, and spot Straits at £166 15s., with the market weak. Possibly as a result of lower values sales during the week have been fairly large, yesterday about 200 tons changed hands on recessions down to 29c., while on Monday 100 to 150 tons was sold at 29.75c. down to 29.25c., New York. On June 3 there were sales of June-July shipment at 30.50c. with sellers at the close at 30.25c. A feature of the spot market has been its closely held character. Deliveries into consumption in May were 1225 tons with stocks and landing on May 31 at 2571 tons. Imports to June 1 were only 7353 tons, against 23,013 tons to June 1, 1920. Arrivals thus far in June have been 505 tons with 2150 tons reported afloat.

An interesting observation is that one consumer, who ordinarily uses 50 to 75 tons of tin per month, has bought only 20 tons since September.

LEAD

The course of the market has been much the same as the week previous: Characterized by the pressing of speculative lots at St. Louis until on Monday these were offered at 4.60c., St. Louis, or 4.90c., New York. There has been very little buying, however. Probably as a result of this tendency the leading interest on Monday lowered its quotation from 5c., New York and St. Louis, to 4.75c., both locations, for early delivery. The St. Louis quotation of the outside market is consequently a little lower. We quote the market at 4.50c., St. Louis, or 4.75c., New York, for early delivery, with demand light and the tendency easy.

ZINC

There is absolutely no improvement in demand or sales which are still confined to small lots for early delivery. There has been a decline in values, the market falling by its own weight. Prime Western for early delivery is quoted at 4.55c., St. Louis, or 5.05c., New York, with the probability that this could be shaded to 4.50c., St. Louis, or 5c., New York.

ANTIMONY

Wholesale lots for early delivery are quoted a little lower at 5.20c., New York, duty paid. Spot antimony can be obtained at 5 12½c. and has sold at this figure.

ALUMINUM

The market is unchanged with wholesale lots of virgin metal, 98 to 99% pure, quoted by the leading maker at 28c. f.o.b. plant, for early delivery, with metal of the same grade of foreign origin available and sold at 23 to 23.50c., New York.

ORES

Tungsten: Demand is negligible and consumers and dealers are entirely uninterested. Prices therefore are nominal at \$3.25 per unit for Chinese ore and at \$4 per unit for other brands, domestic and Bolivian.

Ferro-tungsten is unchanged at 48 to 58c. per pound of contained tungsten in lump form, guaranteed.

Molybdenum: There is no demand and quotations are unchanged at 50c. per pound of MoS₃ in regular concentrate.

Manganese: High-grade foreign ore is in poor demand at a nominal quotation of 22.50c. per unit, seaboard.

Manganese-Iron Alloys: Demand for both ferro-manganese and spiegeleisen is very light and confined to small lots for early delivery, with quotations nominal at \$75, seaboard, for the British and at \$80 for the American ferro-manganese and at \$30 for spiegeleisen. Production of ferro-manganese and spiegeleisen in May at 9332 tons was the lowest in 20 years and compares with 8360 tons in January 1911, the next lowest figure.

INDUSTRIAL PROGRESS

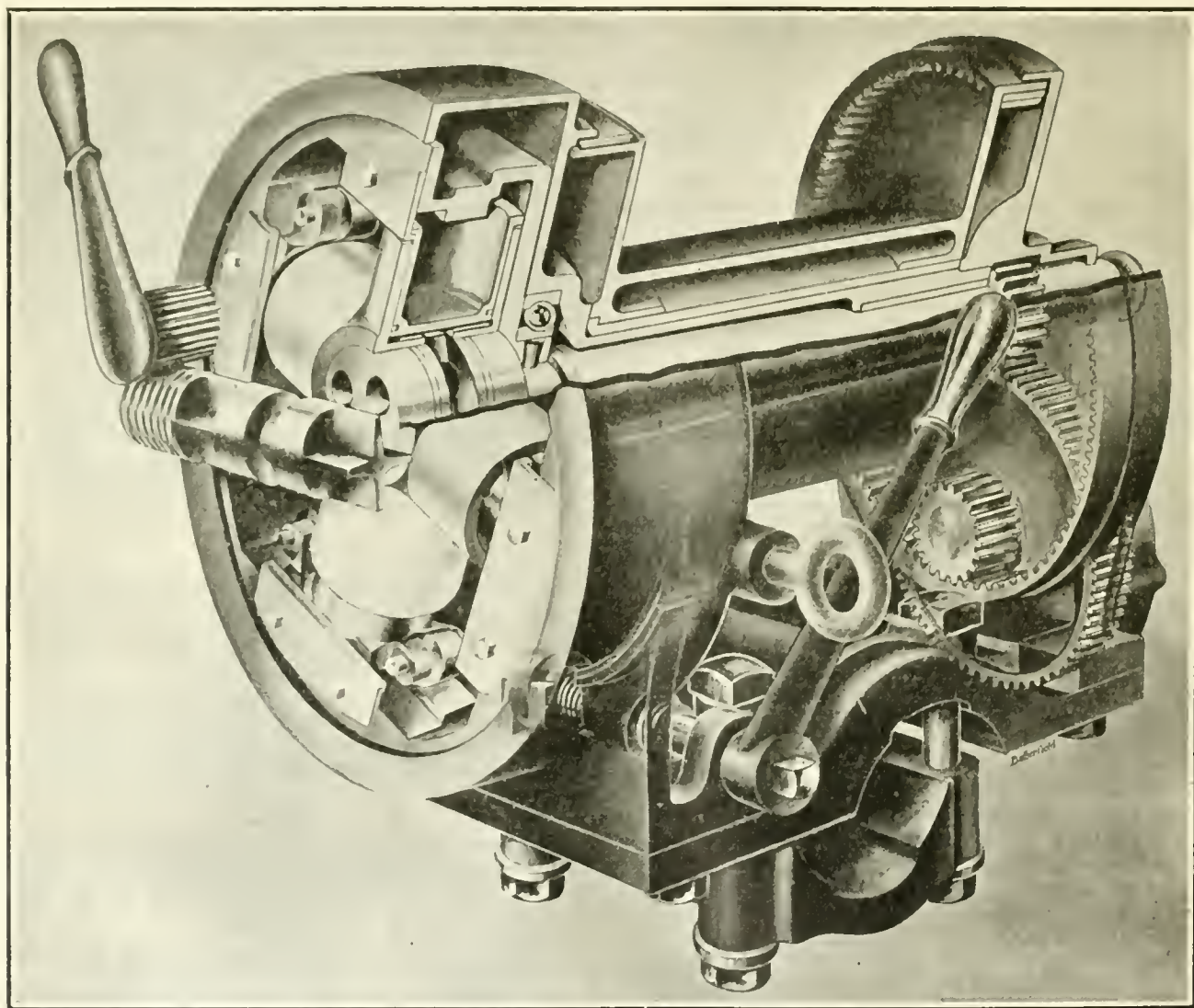


INFORMATION FURNISHED BY MANUFACTURERS

THE WAUGHOIST

Engineers of all ages have sought to develop rotary engines because they have realized that they are superior to those of the reciprocating type, and while they have perfected quite a variety of these engines, no entirely successful

by the new 'Waughoist'. While the 'Waughoist' outwardly resembles a number of other hoists in a general way, and is of about the same size and weight as the conventional types now on the market, it contains many vitally important new features by which it is distinguished from all competing



Waughoist—a Portable Rotary Air-Driven Hoist

hoisting-engine of the rotary type had ever been produced until the recent appearance of the 'Waughoist'. In 1858, Ericsson brought out the first compressed-air hoist, which was used in warehouse work in New York. Since Ericsson's time, air-hoist design has progressed by leaps and bounds, but it may be conservatively stated that no such forward step in hoist design has ever been taken as that represented

machines. Chief among these new features is the engine, which is as efficient in performance as it is unique in design.

The 'Waughoist' engine was designed as a rotary engine, first, because it is generally recognized as an elementary fact that machines having a rotary motion have decided advantages over those of the reciprocating type, and, second, because it was found that such a machine would develop a

great deal more power and use less air than the ordinary type.

The accompanying sectional view shows the various parts of the engine in relation to each other. The principal parts are: the motor-housing, the distributor, the cylinder-block, the spider, the spider-shaft, and the pistons.

The whole engine revolves within the motor-housing, an oil- and air-tight casting which protects the engine from the atmosphere and also serves as an oil-reservoir.

The distributor, through which the air is supplied to the cylinders, is a hardened and ground stationary steel shaft which serves not only as a distributor of power, but as a support for the cylinder-block as well. Fixed to the spider-shaft is the spider, a drum-shaped casting, which revolves within the motor-housing and within which the cylinder-block also revolves. Around the inner side of the spider four hardened and ground steel tracks are mounted, on which the piston-rollers run. The spider-hub is mounted on a ball-bearing.

The spider-shaft is a carefully heat-treated alloy-steel shaft upon which the cable-drum revolves. A clutch-pinion is mounted on the small end of the spider-shaft so that the cable-drum gearing can be disconnected from the engine and the drum permitted to run free when desired.

Within the four cylinders are four carefully heat-treated, precisely-ground, drop-forged, alloy-steel pistons, which, as the cylinder-block revolves, work in the cylinders and at the same time roll the piston rollers along the track-plates on the inner side of the spider, thus practically eliminating the sliding surface friction common to all other types of engines.

Not long ago a sectionalized model of the 'Waughoist' was shown for the first time at a meeting of the American Mining Congress, where it proved to be the sensation of the exhibition. Engineers from all sections manifested the keenest interest in the construction of the machine and were frankly mystified by its amazing efficiency. Almost without exception, after a demonstration, the question was asked on every side, "What makes it go?"

By referring to the sectional view, the idea of the operation of the machine will be readily grasped. Throughout the description it should be kept in mind that the cylinder-block is set in the spider, eccentric to the spider-shaft, by means of which the cable-drum revolves. Compressed air is admitted to the machine through an opening (not shown in the sectional view) against the control-valve.

When the control-valve throttle is thrown open, the air rushes through the narrow portion of the valve into the air ports on one side of the distributor, passing through it to the distributor-slot on the corresponding side. At this point the distributor is divided by a partition into two chambers. Reaching the distributor-slot, the air is admitted through the cylinder-ports into the cylinders which happen to be in contact with that side of the distributor-slot. Recall here that the cylinder-block is set in the spider off centre, but that the spider is mounted on the spider-shaft at its centre. Now, as the air is admitted into the cylinders on one side of the distributor-slot, it pushes against the pistons, which are held to the roller-tracks by flanged-steel plates and this push, aided by the off-centre movement of the cylinders en bloc, and the sliding movement of the pistons along the roller tracks, revolves the cylinder-block and the spider with it.

While the air is being admitted on one side of the distributor, it is being exhausted through the piston-ports on the other, and to reverse the machine instantly it is only necessary to push the control-lever in the opposite direction, which reverses the function of the air-ports so that the side in which it has a moment before been admitted becomes the exhaust side and vice versa.

One of the most noticeable faults of the ordinary hoist is the excessive vibration set up when the machine is in opera-

tion. In the 'Waughoist', vibration is negligible at all speeds and loads. Unlike any other portable hoist, it vibrates so little that it can be run free at high speed without being fixed to any foundation, and its purring motor runs as smoothly and easily as that of the finest automobile engine.

While the 'Waughoist', coming fresh from the factory, is thoroughly efficient, and possesses a horse-power that is surprising in so small a machine, its potential horse-power is much greater, and a gradual, continual, and substantial improvement may be counted upon for a considerable length of time after installation. In this respect the 'Waughoist' resembles an automobile engine, which is invariably more efficient and powerful after having been 'run in'.

In proportion to its size and weight, the speed and load possibilities of the 'Waughoist' are greater than those of any other portable air-hoist. The descent of a heavy load may be speeded up by a full head of high-pressure air and, by shifting the control-lever, the engine can be instantly reversed from full speed ahead without the least injury to the mechanism.

HERCULES POWDER CO. ABSORBS AETNA COMPANY

Rumors of the proposed purchase of the Aetna Explosives Co., Inc., by the Hercules Powder Co. received definite confirmation on June 6 when the Aetna stockholders sanctioned the sale of its properties, assets, and business. This marks the culmination of a transaction that has interested financial and business circles for the past two years, and which in addition to being a deal of considerable moment also presents an unusual legal aspect.

Although it has been understood practically since the close of the War that negotiations were under way between these two manufacturers, it was not until the petition of the Hercules company for permission to purchase the Aetna company had been acted on favorably by the Circuit Court of Appeals, sitting as the United States Court for the District of Delaware, that the proposition assumed definiteness. The Hercules company was originally created by a decree of a Federal court in an action brought by the United States against the du Pont company under the Sherman Act. Although not a party to this action, the Hercules company is bound by certain injunctions in the final decree, and for this reason it was deemed necessary to petition the court for permission to effect the present transaction. On May 4, a decision was rendered on the Hercules company's petition, sanctioning the purchase of the Aetna company, in which the court expressed itself as convinced that in permitting the Hercules Powder Co. to buy the Aetna company, actual competition would be undiminished and even probably increased, especially as regards the Hercules company's strongest rival, the du Pont company. The case was heard before Judges Buffington, Woolley, and Davis.

Judge Woolley, who wrote the opinion, also pointed out that events have justified the theory of the dissolution decree that the stock control of the Hercules Powder Co. would in time pass out of the hands of those interested in the du Pont company. In this he referred to evidence presented that whereas at the time of its organization less than 1% of the Hercules company's common stock was owned by its directors and employees, on September 15, 1920, this same group held 37.04% of the voting common stock and represented the largest single group interest in the company. This stock, taken together with that which is owned by those having no connections with either company which would vote with the existing management, judged by the usual experience at corporate elections, amounts to control by a substantial majority.

By this purchase the Hercules company will acquire high explosives, or dynamite, plants near Birmingham, Alabama; Emporium, Pennsylvania; Sinnamahoning, Pennsylvania; Ishpeming, Michigan; and Fayville, Illinois; two black-

powder plants, one at Goes Station, Ohio, and the other near Birmingham, Alabama; a plant for the manufacture of blasting-caps and electric blasting-caps at Port Ewen, New York, and a plant for the manufacture of fulminate of mercury, for use in blasting caps, at Prescott, Ontario, Canada.

The explosives industry differs from most others in that it is limited geographically in making sales because of freight-rates. It is only possible to ship such commodities a limited distance from the place of manufacture before a point is reached at which transportation costs make it impossible to compete with other companies having plants nearer the particular consuming centre. The principal significance of this transaction to the Hercules company is that it will in the future, because of the situation of the Aetna plants, be able to enter territories in which it has previously found it unprofitable to sell. It will thereby compete all the more successfully with other explosives manufacturers.

In the unanimous decision of the court on the petition referred to above, Judge Woolley states in part:

"A careful review of the explosives industry set forth by the petitioner in elaborate detail with reference to areas of consumption, number and distribution of producing plants, and competitive conditions, the accuracy of which is in no particular challenged, has convinced us that in permitting the Hercules Powder Co. to acquire the several properties of the Aetna Explosives Co. actual competition in the industry within their respective regions will remain undiminished, though the number of competitors will, of course, be reduced by the withdrawal of one. Indeed, it is persuasively represented that competition will be increased by thus strengthening the Hercules Powder Co. in its contest for business against the du Pont company, its strongest rival. However that may be, we are satisfied, after a careful study of a great volume of data gathered from authentic sources, a recital of which in this opinion is quite impracticable, that the proposed purchase of the Aetna properties by the Hercules Powder Co. will not disturb the position in the industry which the court has made for the Hercules Powder Co.; that it will not abridge the purpose for which the court employs that company in maintaining the separation of the offending members of the combination previously existing; and that it will not throw out of balance the competitive conditions in the industry which the court sought and which evidently it has achieved by the instrumentalities of the Hercules Powder Co."

"With the Aetna company's business, the Hercules Powder Co. becomes a much larger factor in the explosives business of the United States," said J. T. Skelly, vice-president of the Hercules company.

"The company is now in a position to compete for business in all parts of the United States, and will be greatly strengthened in important fields which have hitherto been closed to us on account of freight-rates from our plants.

"The reorganization will take place gradually. As in some cases we already have branch offices in cities where there is an Aetna office, consolidations will be necessary and new alignments of branch-office territories must be worked out. It is our intention to retain as many members of the present Aetna organization as we consistently can, but obviously, one of the great advantages of this purchase will be the reduction in overhead which it will make possible. Ultimately the principal members of Aetna's home office organization will be transferred to Wilmington."

NEW STOPING RECORD ON THE RAND

At the Geduld Proprietary Mines, on the Rand, L. H. Ellitson recently established what is claimed to be a new world's stoping record when in one month he broke 215 fathoms of rock, the previous world's record having been 190 fathoms. Three No. 18 Ingersoll-Leyner drills were

used, the fathoms per machine-shift being 2.56, and 40 tons being broken per machine-shift. The stoping width was 63 in. In the three months preceding the same miner broke 185, 185½, and 190 fathoms, respectively, with the same machine. According to the Union Corporation, Ltd., which operates the Geduld mine in which the record was made, the Leyner stoping in this mine averaged 1.7 fathoms per machine-shift for 1920 for 38 machines running.

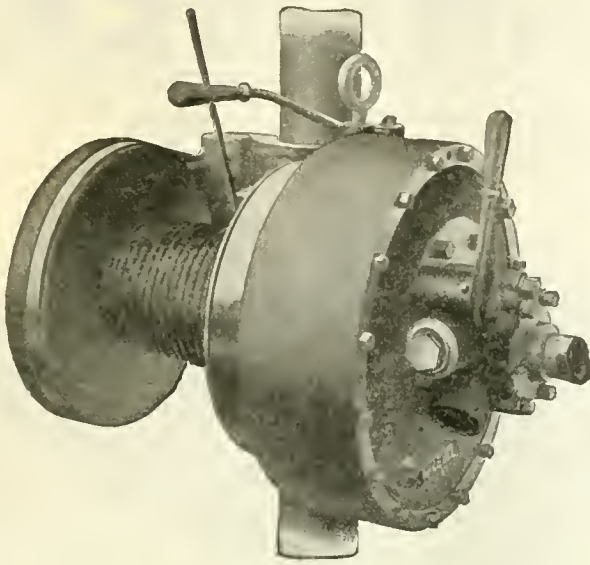
COMMERCIAL PARAGRAPHS

The new P & J shovel-attachment for use with standard P & J types 205 and 206 excavator-cranes is described in Pamphlet SX just published by the Pawling & Harnischfeger Co., of Milwaukee. Illustrations of the shovel attachment in use are shown and the economy of being able to use either the 30-ft. crane-boom or the shovel-boom is pointed out. With the extra expense of only the shovel attachment, the number of applications of this material-handling and digging machine is increased—the shovel, it is said, having the ability to do the work of any steam-shovel of equal weight.

Lunkensheimer 'valve-iron', as found in 'Ferrenewo' valve-bodies, is especially alloyed and processed to provide, in addition to its high tensile strength of 30,000 lb., those peculiar qualities essential to successful results under the wide range of service conditions for which the 'Ferrenewo' valves are adaptable. It should not be confounded with even the better trade-grades of cast-iron. Prior to the development of the 'Ferrenewo' valves the use of small-size globe-, angle-, cross-, and check-valves with ferrous bodies was, for wise and sufficient reasons, not considered as being good engineering practice; and the 'Ferrenewo' was not released to the market until the full merit of its body material had been soundly established. The application of the Lunkensheimer 're-grinding' principle to the construction of 'Ferrenewo' valves has made an ideal product.

A new bulletin recently issued by the New Jersey Meter Co., of Plainfield, New Jersey, describes a forge-blower recently placed on the market. This blower is applicable for coal- and coke-forges used in heating steel for dressing or tempering, supplying air for gas- and oil-furnaces, and for rivet-heating forges. This device turns a small volume of compressed air into a large volume of low-pressure air. To illustrate, a small rivet-heating forge requires an average of 45 ft. of free air per minute to blow the fire. If taken direct from the compressed-air lines, this represents an expenditure of 7.5 hp. With the blower attached, the consumption of air from the lines is less than 2 ft. per minute (representing only ¼ hp.) and the balance or 43 ft. per minute is induced or drawn in from the atmosphere. This is 'free air' with a new and profitable meaning. Seven horse-power saved, on a single forge, may amount in the course of a year to \$300 or more.

In 1902 the Sprague Electric Works developed a small electric hoist to be used in places where it would be difficult or impossible to install electric cranes. Several hundred were manufactured and quickly sold and the users found that they possessed many advantages over chain-blocks, air-hoists, and large electric cranes. Many of these first machines that were built over eighteen years ago, are still in use, and have been giving continuous service since they were installed. To meet the various hoisting requirements of the many industries, several types with various capacities have been developed and many improvements have been made to the original designs. Sprague electric hoists are built in capacities of from one-quarter of a ton to six tons and in two general types, worm-gear hoists and spur-gear hoists, and for both direct current and polyphase alternating currents. Bulletin No. 48,967 recently issued describes a large number of these machines and illustrates uses for which they are particularly applicable.



Here's Your Hoist

YOU'VE been waiting for an air-hoist with more speed, greater power and capacity, higher efficiency and one that would use less air.

WELL, here's your hoist at last—The Waughoist. Driven by an entirely new type of almost frictionless rotary engine, the Waughoist will solve every lifting problem in your mine in a completely satisfactory manner and at the same time materially reduce your operating costs.

LET us tell you more about this remarkable new machine.

Send for a Waughoist booklet today

THE Denver Rock Drill Manufacturing Co.

DENVER, COLORADO

San Francisco
Scranton
El Paso

Los Angeles
Seattle
Salt Lake City

Joplin
Wallace
Birmingham

Lima
Santiago
Duluth

New York City
Houghton
Butte

Melbourne
Johannesburg
Mexico City

Canadian Rock Drill Company, Limited
Sole Agents in Canada

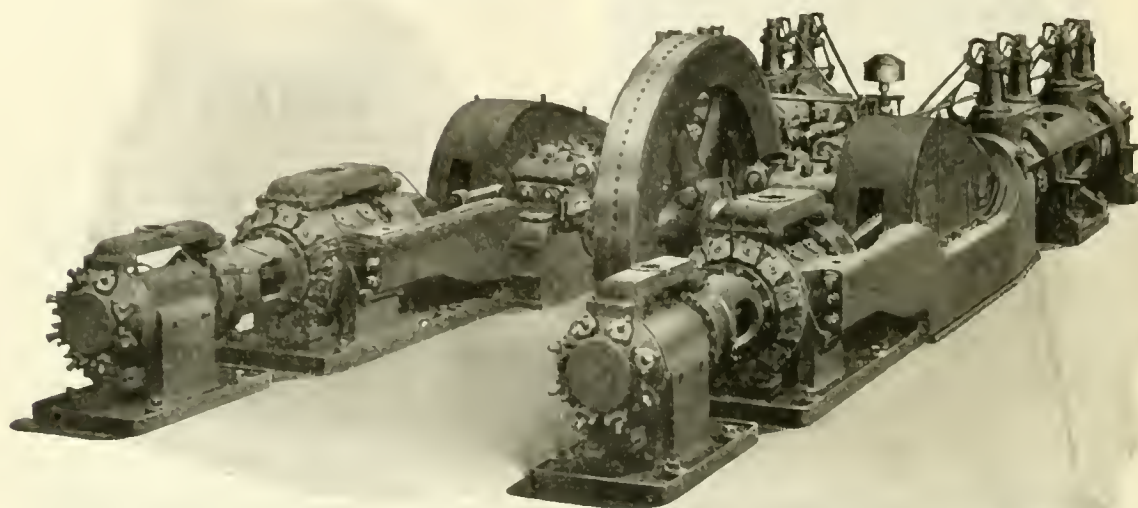
Toronto

Cobalt

Nelson

Vancouver
M-139

ALLIS-CHALMERS



Gas Engine Driven Compressor

With Compressing
Cylinders for
Either Air or Gas



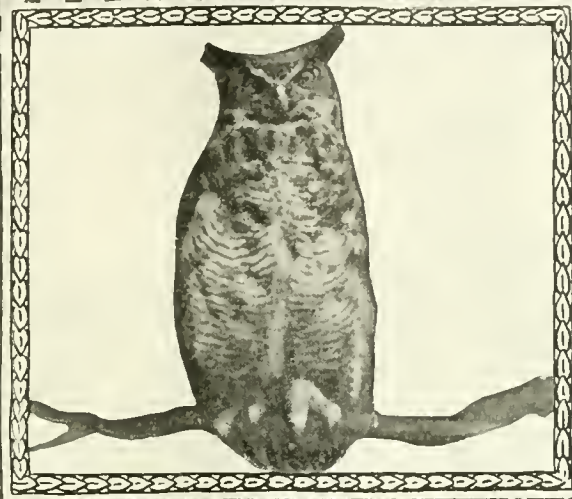
Products

Gas Engines
Steam Engines
Steam Turbines
Condensers
Electrical Machinery
Oil Engines
Hydraulic Turbines
Pumping Engines
Centrifugal Pumps
Mining Machinery
Metallurgical Machinery
Crushing and Cement Machinery
Flour Mill Machinery
Saw Mill Machinery
Air Compressors Air Brakes
Steam and Electric Hoists
Farm Tractors
Power Transmission Machinery

ALLIS-CHALMERS MANUFACTURING COMPANY

Milwaukee, Wisconsin, U. S. A.

District Offices in All Principal Cities



To suggest
the Wisdom of
Specifying
“**Perfect**”

Double Crimped
Wire Cloth
and
REK-TANG SCREENS



The Ludlow-Saylor Wire Co
St. Louis, Mo.
U.S.A.

"Sullivanize" Your Drill Steel



Sullivan Drill Steel Furnace, Showing Installation with Sullivan Drill Sharpener; from a motion picture.

YOU can increase the speed of drilling rock in your mine, and cut your bills for drill repairs and broken steel, by heating your bits and shanks in the Sullivan Oil or Gas Drill Steel Furnace and hammer-forging them the Sullivan way in the Sullivan Sharpener.

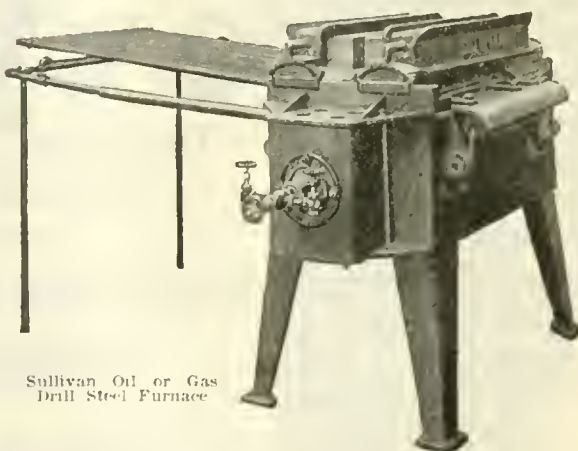
One large copper company has increased its drilling 30% and cut its drilling cost 21% by adopting Sullivan methods.

On tempering alone, a Sullivan Furnace has reduced by one-half the number of steels used at a large Iron Mine. Before, not one steel in 25 would stand up to the drilling. Since this furnace has been started, less than one in 25 steels fails to stand up.

The average number of broken steels per day at this mine has been reduced from 85 to 6½.

*Sullivan Drill Steel Furnaces
Bulletin 1374*

*Sullivan Drill Sharpeners
Bulletin 1372-E*



Sullivan Oil or Gas Drill Steel Furnace

SULLIVAN MACHINERY COMPANY

123 So. Michigan Ave., Chicago,

580 Market St., San Francisco.

DOMESTIC SALES OFFICES:

Birmingham, Boston, Butte, Claremont, N. H., Cleveland, Dallas, Denver, Duluth, El Paso, Huntington, W. Va., Joplin, Juneau, Knoxville, New York, Pittsburgh, St. Louis, Salt Lake, San Francisco, Spokane.

FOREIGN SALES OFFICES:

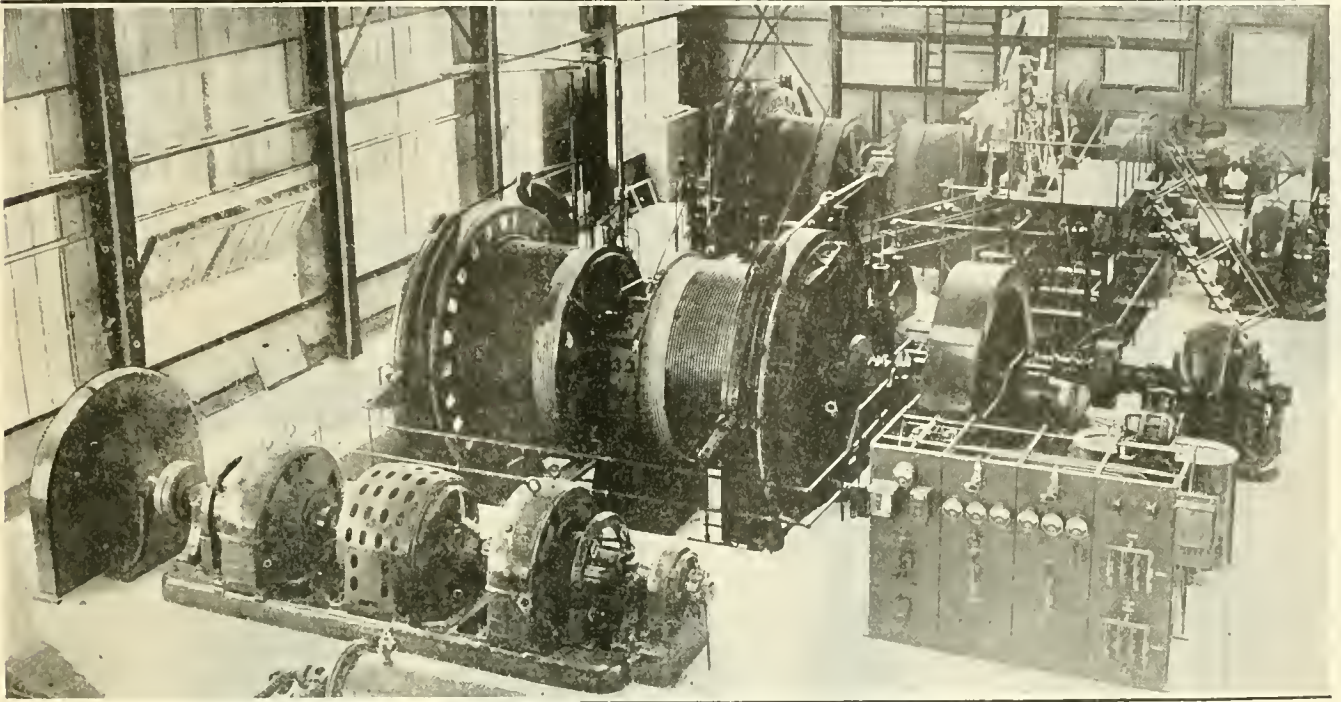
Algiers, Brussels, Calcutta, Christiania, Durban, Natal, Havana, Lima, London, Madrid, Mexico City, Paris, San Juan, Santiago, Shanghai, Sydney, N. S. W., Tokyo, Toronto, Tunis, Turin, Vancouver.



SULLIVAN PRODUCTS

Air Compressors; Air Lift Pumps; Diamond Drills; All-Hammer Drill Sharpeners; Drill Steel Furnaces; Forge Hammers; Ironclad Coal Cutters; Rock and Hammer Drills; Quarrying Machinery; Contractors for Diamond Core Drilling.

As Necessary as Proper Hoisting Equipment



—the Monroe lifts the burden of mine-office figuring

THE pivotal point in the mine is the hoist. Production depends on its efficiency and reliability. It must be ready at all times to bring up the tonnage required to keep the mill running to capacity.

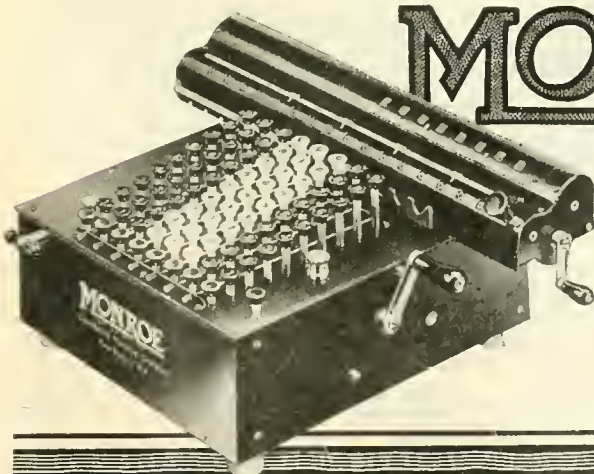
Equally important in the mine-office is the Monroe Calculating Machine. It is always ready to handle the loads of figure-work incident to getting out reports, computing averages and tonnages, making up pay-rolls, calculating cost estimates, surveys and percentages. Routine figuring or intricate calculation—both are handled easily and ac-

curately—and with positive proof of a correct result always in sight.

The Monroe is simple to operate—a turn of the crank forward to add or multiply—backward to divide or subtract. Nothing could be simpler than the Monroe "Two-way" mechanism.

Put the same care into selecting mine-office equipment as went into the selection of your hoist. Decide now to put in a Monroe—and rest assured that the question of "figure-work capacity" is settled.

Send the coupon for more complete information. No obligations, whatsoever.



MONROE

REG. U. S. PAT. OFF.

Calculating Machine

The "SHOW ME" Coupon—Mail it today

Monroe Calculating Machine Co., General Office, Woodworth Bldg., New York
 Pacific States Division Manager: W. H. Brown, 417 Market St.,
 San Francisco

☐ Without placing us under any obligation from you, send "MAKE
 YOUR OFFICE AS EFFICIENT AS YOUR MINE" folder and
 other information about the Monroe Calculating Machine.

☐ Arrange for a Monroe man to call and demon-
 strate the machine on your own work.

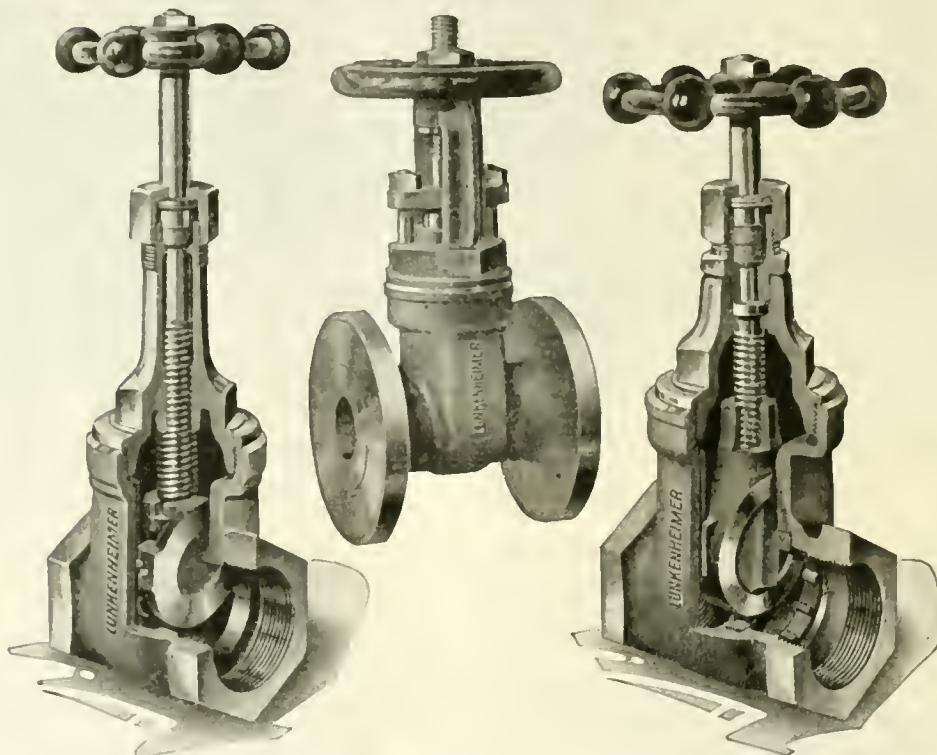
Firm Name
 Your Name
 Address

M. & S. P.
 6-25-21



LUNKENHEIMER

Bronze Gate Valves



LUNKENHEIMER BRONZE GATE VALVES remain tight under extreme operating conditions because the design is correct, the material is the well known LUNKENHEIMER "Valve-Bronze" and they are made with the skill which characterizes all LUNKENHEIMER Products.

The "double taper wedge seat" construction embodied in LUNKENHEIMER Bronze Gate Valves has proved its practicability. In addition to tightness, it insures ease of operation, minimum wear and consequent long service life.

The DOUBLE DISC TYPE for pressures up to 150 pounds has a simple and practical ball and socket bearing between the discs which makes them self adjusting and eliminates the needless maintenance cost prevalent on valves employing a greater number of working parts.

The WEDGE DISC type has a single disc, with the seats finished in exact alignment with the disc faces, and the seatrings are renewable on sizes one inch and larger. Made with Inside Screw Stationary Stem, and with Outside Screw and Yoke Rising Stem for pressures up to 200 and 300 pounds.

LUNKENHEIMER BRONZE GATE VALVES are obtainable from LUNKENHEIMER Distributors situated in every commercial center. Insist on having the genuine.

THE LUNKENHEIMER CO.
— "QUALITY" —

LARGEST MANUFACTURERS OF
HIGH GRADE ENGINEERING SPECIALTIES
IN THE WORLD

NEW YORK
CHICAGO

CINCINNATI

BOSTON
LONDON

EXPORT DEPT. 129-135 LAFAYETTE ST., NEW YORK

CURRENT EDITION
OF CATALOG BEARS
No 58
COPIES PROCURABLE FROM
LUNKENHEIMER
DISTRIBUTORS

11012-8-34

Traylor Talks

A Word About Traylor Copper Converters

20-ft. TRAYLOR Great Falls Type CONVERTER

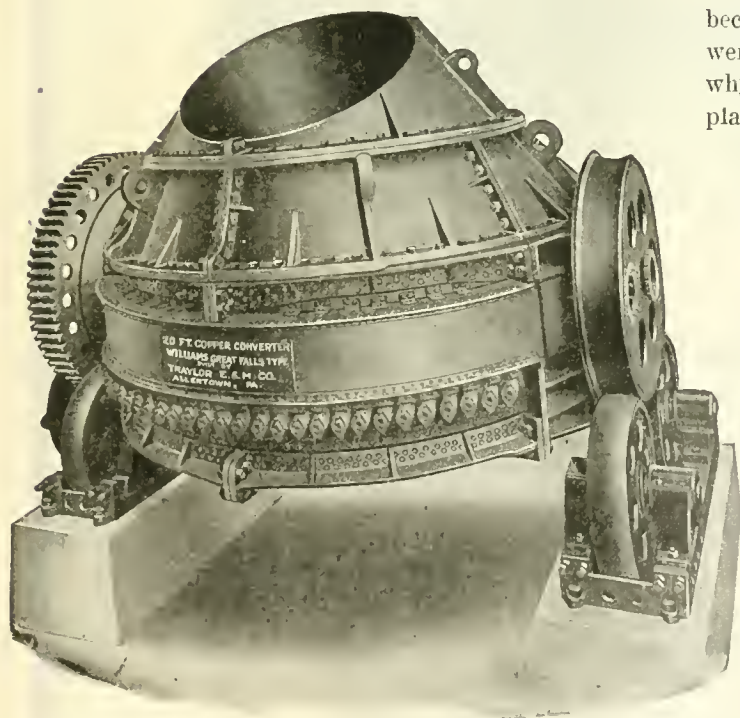
Tuyere boxes with Williams connections can be detached without disturbing the Tuyere pipes. They save the lining.

Write for information.

This business of ours has been built up around the words "so designed". There is real study behind every piece of Traylor equipment—study to produce apparatus which will do its work better, with less trouble and more economically.

In the case of Traylor Copper Converters the big feature is the removable Tuyere—any tuyere can be detached without interfering with the others and the Tuyere Boxes can be removed without disturbing the Tuyere Pipes.

Traylor Copper Converters have cut operating costs because of these features. That is what the study that went into their design was meant to do. And that is why they are used in so many large and efficient smelting plants.



Traylor Engineering & Manufacturing Co.

ALLENTOWN, PA.

New York Chicago Pittsburgh
Los Angeles Spokane

Truck and Tractor Division:

CORNWELLS, BUCKS CO.,
PA.

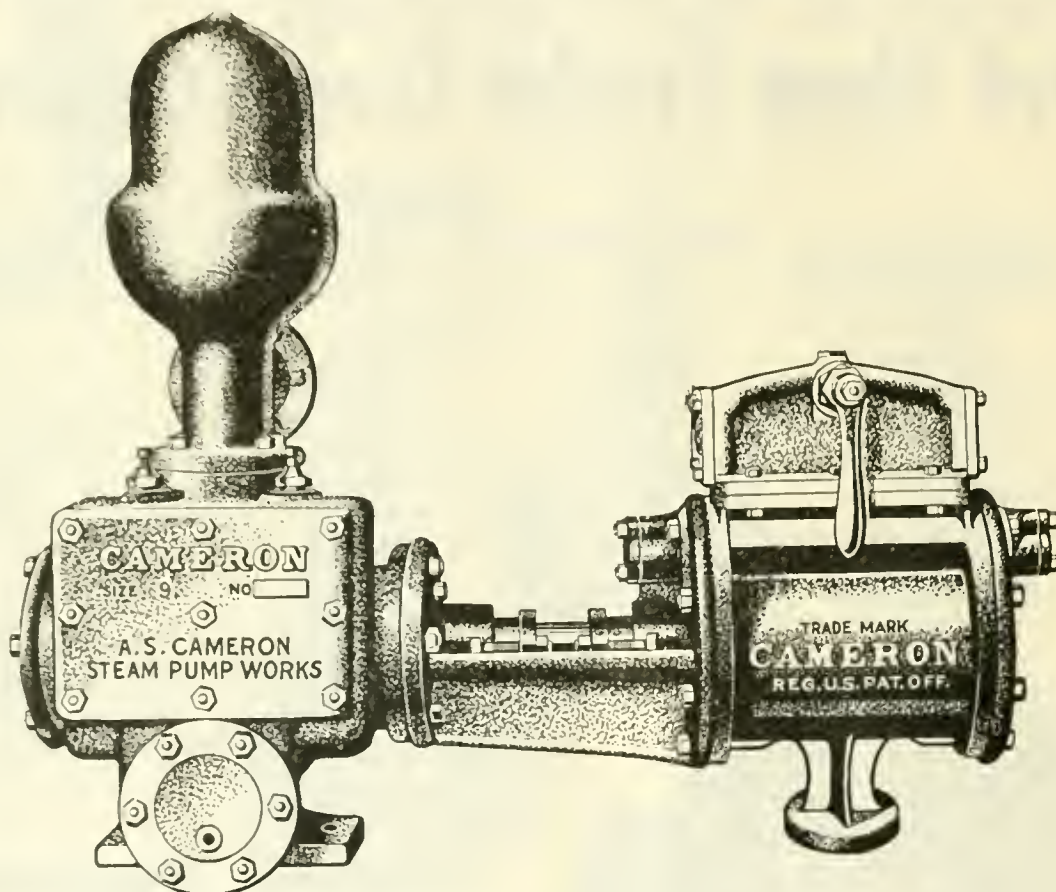
STOCK DELIVERY

7"x10" BLAKE TYPE JAW CRUSHER
10"x20" BLAKE TYPE JAW CRUSHER
No. 5 GYRATORY CRUSHER
36"x16" TYPE "A" CRUSHING ROLLS
54"x20" TYPE "AA" CRUSHING ROLLS

TRAYLOR MOTOR TRUCKS

FOR HAULING, AND TRAYLOR ALL-PURPOSE TRACTORS FOR THE 101 OTHER JOBS, WILL MAKE THE RANCH OR FARM AS EFFICIENT AS THE SMELTER EQUIPPED WITH TRAYLOR FURNACES AND CONVERTERS.

CAMERON PUMPS



'Way down in the sub-cellar you will often find a pump resting on a couple of ancient chunks of wood. Nine times out of ten it's a Cameron and you will always find it working. Out in the rain, wind and snow, in the mining sump knee deep in water, here, there and everywhere, you stumble over a Cameron Pump and wonder that a piece of machinery can work under such conditions—but the Cameron doesn't care—that's what it is made for.

*Send for Bulletin 7304. It tells
about the Pump which lasts*

INGERSOLL-RAND COMPANY

A. S. CAMERON STEAM PUMP WORKS

11 Broadway, New York

Offices the world over

82-S

When you're drilling from both ends against time, and you must keep down costs———use "LEYNER-INGERSOLLS"



High air pressures, fast drilling and rough usage should not be associated in your mind with excessive upkeep costs.

"Leyner-Ingersoll" rock drills are designed and built to stand the strain of these conditions.

They will give continued satisfactory service month after month.

"Leyner-Ingersolls" are durable and economical, as well as speedy drillers.

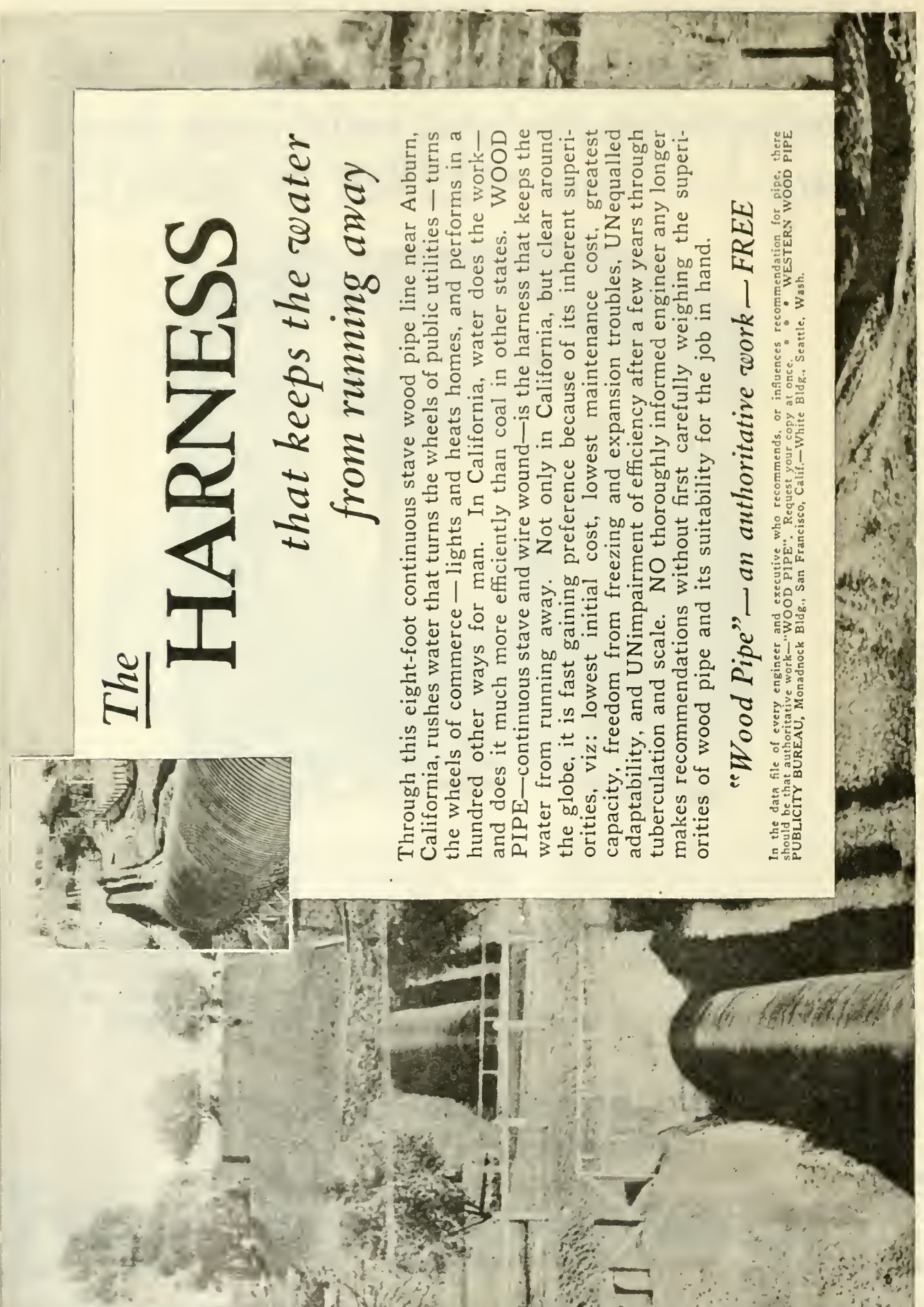
One reason for their durability is their all-steel, drop-forged construction.

One reason for their economy is their utilization of the expanding force of the compressed air—that is, getting more work out of less air.

INGERSOLL-RAND COMPANY

General Offices: 11 Broadway, New York

Ingersoll-Rand



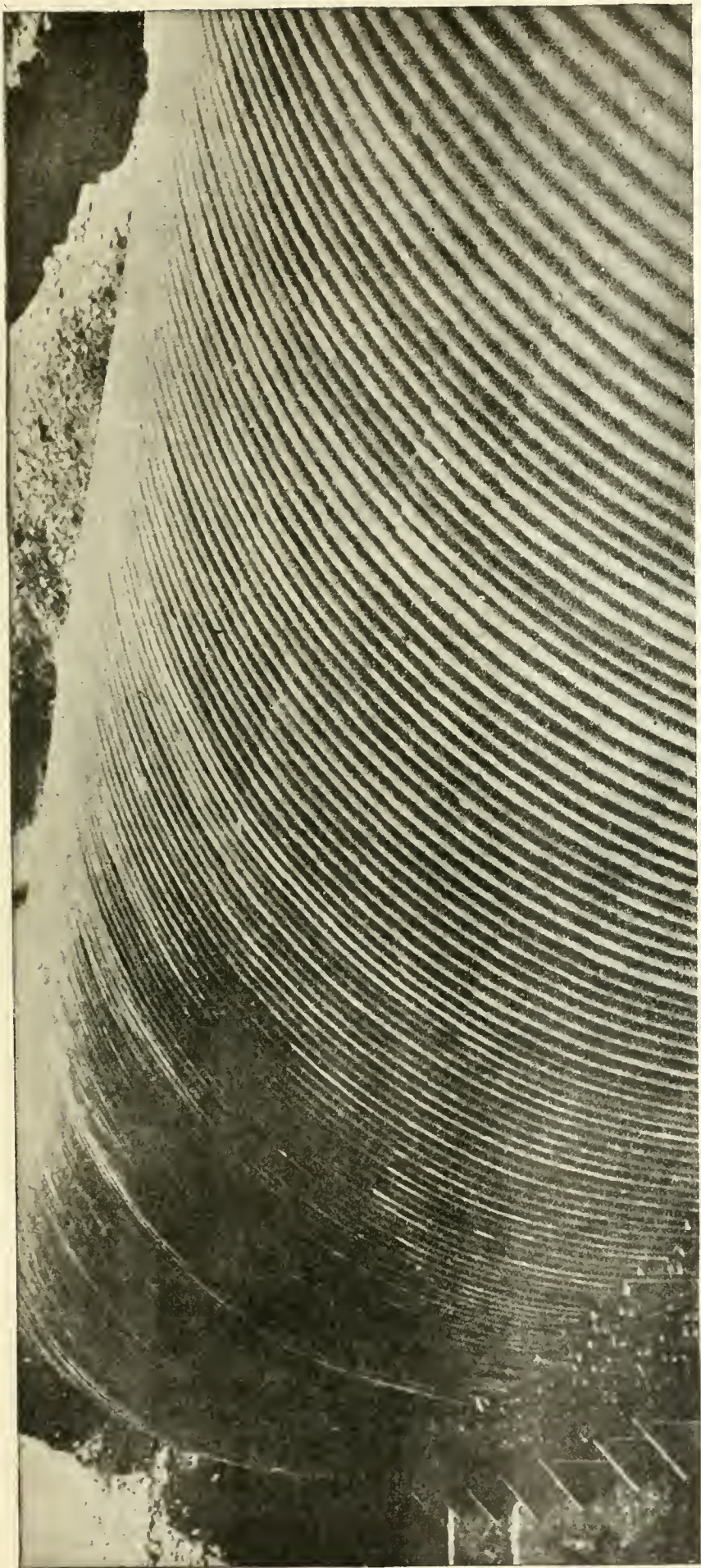
The HARNNESS

*that keeps the water
from running away*

Through this eight-foot continuous stave pipe line near Auburn, California, rushes water that turns the wheels of public utilities — turns the wheels of commerce — lights and heats homes, and performs in a hundred other ways for man. In California, water does the work — and does it much more efficiently than coal in other states. WOOD PIPE — continuous stave and wire wound — is the harness that keeps the water from running away. Not only in California, but clear around the globe, it is fast gaining preference because of its inherent superiorities, viz: lowest initial cost, lowest maintenance cost, greatest capacity, freedom from freezing and expansion troubles, UNEQUALLED adaptability, and UNIMPAIRMENT of efficiency after a few years through tuberculation and scale. NO thoroughly informed engineer any longer makes recommendations without first carefully weighing the superiorities of wood pipe and its suitability for the job in hand.

"Wood Pipe" — an authoritative work — FREE

In the data file of every engineer and executive, who recommends, or influences recommendation for pipe, there should be that authoritative work—"WOOD PIPE". Request your copy at once. • • • WESTERN WOOD PIPE PUBLICATION BUREAU, Monadhock Bldg., San Francisco, Calif.—White Bldg., Seattle, Wash.

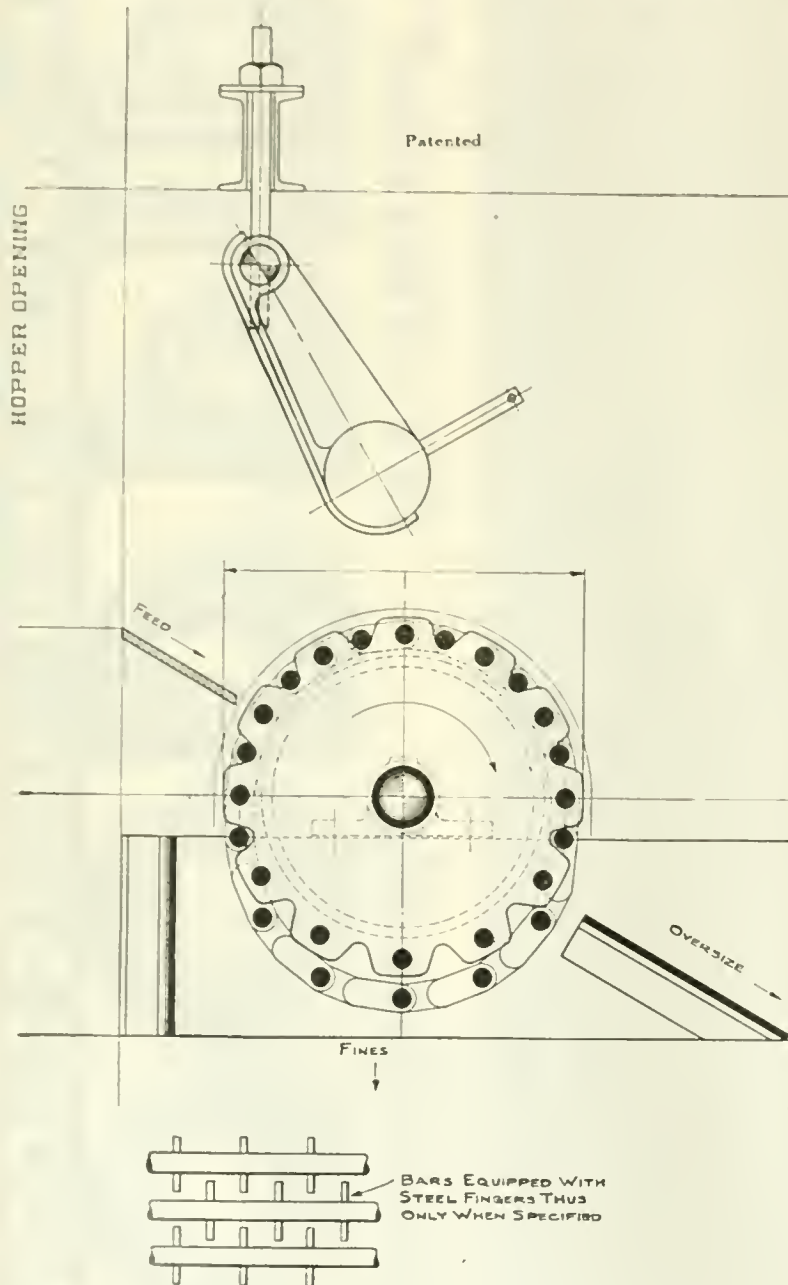


Douglas Fir

Redwood

WOOD PIPE
CONTINUOUS STAVE-WIRE WOUND-BORED

ROSS AUTOMATIC DROP BAR GRIZZLY FEEDER and SCREEN



For use in Mining, Smelting, Sand, Gravel, Crushed Stone, Coke, Blast Furnace and numerous other Plants.

Cannot block or choke —will handle material at an even rate for 24 hours a day without labor or attendance.

Replaces all types of Revolving Screens at a less cost per unit and less cost for horse power with greater tonnage and less repair cost.

Manufactured and Sold Exclusively by

CHALMERS & WILLIAMS

1405 ARNOLD STREET, CHICAGO HEIGHTS, ILL.

The Strength of a Belt Is In Its Lacing

Sudden Breaks Mean Production and Time Loss

That Weak Joint May Cost a Thousand Dollars to Repair

The sudden stoppage of the machinery in a factory always means a distinct loss. When machinery is idle, production stops; the morale of the workmen is temporarily broken. All this because of a poor job of belt lacing—or poor lacing.

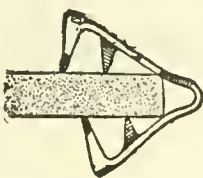
Avoid This Loss—Lace Belts Right

The above condition exists wherever steps have not been taken to correct the recurring, costly evil of poor belt lacing. This loss, this waste, is all unnecessary. No manufacturer is compelled to stand this tribute to carelessness or ignorance—if system and care and knowledge be applied to the belt lacing. It is as important as the selection of a belt or checking costs on belt overhead.

There is a valuable guide to proper belt lacing and the sooner Purchasing Departments discover it, from that point on belt troubles will be uncommon visitors—as far as the lacing is concerned.

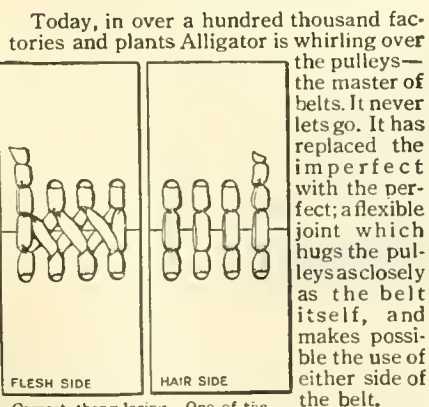
Preference Given to Alligator Steel Belt Lacing by Belt Men

A belt lacing that has proven successful when others have failed is Alligator Steel Belt Lacing. Its healthy, unyielding grip on belts of all kinds, makes and sizes, has forced the admission that here is at last a belt fastener that fulfills all the promises of the manufacturers.



Actual size of No. 25 Alligator for single leather or 4-ply fabric 3-16 to 9-32 thick. Note double staggered teeth.

Makes a Smooth Flexible Joint



Correct thong lacing. One of the best until Alligator came.

The sectional frictionless, steel rocker hinge pin helps to make this flexibility a notable fact.

Punching Holes in Belt Is Wrong Method

The greater strength of the Alligator laced joint has been verified in hundreds of thousands of tests. One reason why is that where other metal fasteners weaken the belt by cutting most of the lengthwise fibres of the belt, the fibres that carry the strain, the teeth of the Alligator Lacing penetrates the belt lengthwise and clinches across the long burden carrying fibres leaving them intact, as the teeth pass between them.



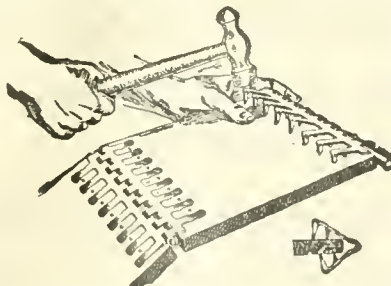
Showing teeth disengaged with steel rocker hinge pin. And in proper position back to back. Also completed joint.

The breaking strength of an Alligator laced belt is, therefore, at a considerable higher figure, naturally, than those whose strength is graduated by the number of punch holes made for rawhide lacing or some metal fasteners.

It is no wonder then that the well informed belt expert, purchasing agent, belt manufacturer and the intelligent shopman swear by Alligator as the most economical, durable and generally satisfactory all-around belt lacing on the market.

Nothing Needed But a Hammer

Comparison with other lacing processes will at once distinguish Alligator as the lacing most quickly and easily applied, even by an inexperienced workman.

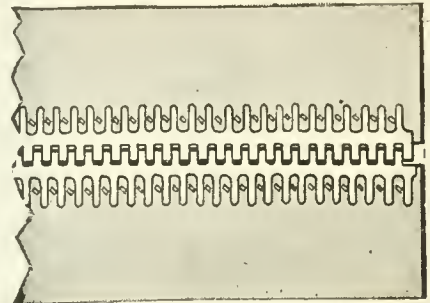


Nothing needed but a hammer to apply it—and you already have a hammer.

There's nothing needed but a hammer, and three minutes is the average time required to make a neat and perfect joint in a workmanlike manner—a joint that holds with a permanent tenacious, viselike, unyielding grip on all belts from tape to 5½-inch thickness.

Good Judgment Dictates a Proven Lacing

There is no question but that Alligator Steel Belt Lacing will go farther in reduc-



Section of Belting laced with "The Strongest Belt Lacing on Earth"

ing annual belt overhead and losses of time and production if consistently used. With belt ills, due to lacings, reduced to a minimum by a universally approved belt fastener, the cost of maintenance will quickly take a consequent downward trend. To Alligator it means nothing more than a duty well done.

Get Free Copy of Our Belt Book, "Shorts Cuts to Power Transmission"

This complete book—laced carefully worked out on a basis of what the average man who handles belts needs to know about them. It was designed especially for engineers, master mechanics, purchasing agents, foremen and plant executives. The book gives practical working data for calculations, care and selection of belting, tells how to estimate for new belts; about the knack of meeting knotty transmission problems—all things which up-to-date men should know. Send for a copy now. Now in use in engineering and technical schools—in quantities to provide for each student.

Do you wish to know further details as to prices, sizes, etc., then fill out blank and mail in today. No obligation.



Flexible Steel Lacing Co.

4635 Lexington St., Chicago
135 Finsbury Pavement, E. C. London

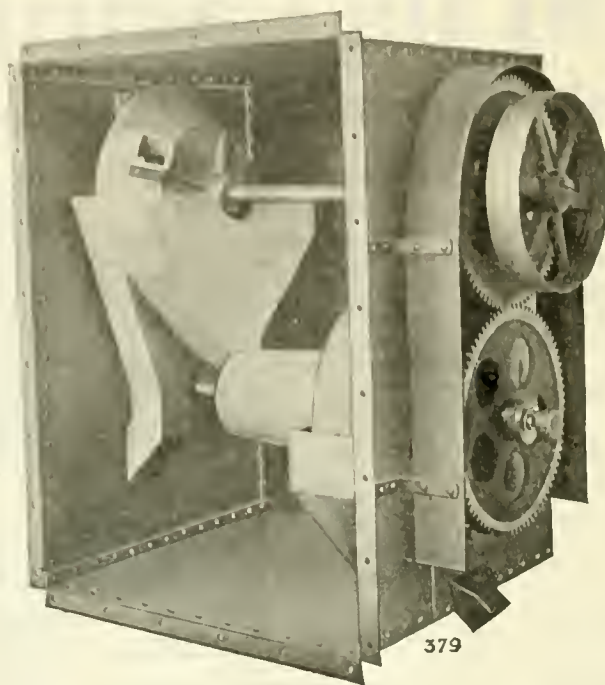
Flexible Steel Lacing Co.
4635 Lexington Street, CHICAGO

Gentlemen:—Without obligation on my part kindly send me price lists, and complete details on Alligator Steel Belt Lacing and indicate a convenient source of supply. Also your book "Short Cuts to Power Transmission."

Firm Name.....

Address.....

Name of Inquirer.....



YOUR UNCLE SAMUEL

is using this new sampler to
SAMPLE VALUABLE RADIUM ORES

—will sample to 1-400—

and be accurate within one per cent.

POSITIVELY DUST PROOF.

Door removed so you can see the Brains of
the thing.

Can be cleaned quickly.

THE WILLIAM A. BOX IRON WORKS COMPANY

DENVER, COLORADO

ENGINEERS AND MANUFACTURERS
of MINING MACHINERY

WHEN Loysteel economy, or long wearing life, impresses you as extraordinary, remember that the real source of those qualities is the high grade alloy steel from which they are made and the scientific heat treatment given them.

Then remember that this steel and heat treatment is found solely in Loysteel products.

If we have been able to make Loysteel Grinding Balls, Stamp Shoes, Grinding Rods and Mill Liners better products and a better paying investment to our customers—and they will tell you that we have—it has been due, not only to the fact that they are made in the oldest and largest alloy steel works in the world, but the care and skill with which those facilities are employed.

We make note of these things because they explain, in simple terms, why Loysteel products are so excellent in quality, so unusual in economy, and such an exceptional value from the user's standpoint.

HICKOK AND HICKOK

Originators and Sole Distributors of LOYSTEEL Products

HOBART BLDG., SAN FRANCISCO

Title Insurance Bldg., Los Angeles

Henry Bldg., Portland, Ore.

MIDVALE

MINE SPECIALTIES

ROLL SHELLS, RING DIES and TIRES

EVERY mill superintendent is familiar with the uniform quality and excellent service obtained for years from Midvale Roll Shells, Ring Dies and Tires made at our Nicetown Plant. Heavy forgings of all kinds are also a specialty.

Send us your inquiries

*Midvale Mining Drill Steels
Midvale Hollow Drill Steel and
Carbon Tool Steels*

A large stock of these well-known steels is carried in San Francisco for immediate shipment. Write our San Francisco office for special stock list.

Midvale Steels are also carried in stock at Chicago, Cleveland, New York, Boston, and Philadelphia.

**MIDVALE STEEL AND ORDNANCE CO.
CAMBRIA STEEL CO.**

General Sales Office
WIDENER BUILDING, PHILADELPHIA, PA.

District Sales Offices
Atlanta, Boston, Chicago, Cincinnati, Cleveland, Detroit, New York,
Philadelphia, Pittsburgh, San Francisco, Salt Lake City, Seattle, St. Louis

Sole Export Representative
CONSOLIDATED STEEL CORPORATION, 165 Broadway, New York
All export inquiries should be sent to this address

DRILLING DEEP HOLES WITH COCHISE ROCK HAMMER



The accompanying picture shows the Cochise Drill used in drilling 20 ft. holes in a road cut by White & Hoffman

Contractors as well as Miners like
COCHISE DRILLS because they
are **GOOD** drills.

COCHISE MACHINE COMPANY
LOS ANGELES, CALIFORNIA

AGENTS:

Rlx Compressed Air & Drill Co.
San Francisco, Cal.

The Mine & Smelter Supply Co.
Salt Lake City, Utah

Arizona Mine Supply Co.
Prescott, Ariz.

Western Machinery & Equipment Co.
Spokane, Wash.

Jack Alyward Co.
Goldfield, Nev.

S. P. Wright & Co.
Butte, Mont.

U. S. Iron Works
Seattle, Wash.

"Tensation"

A New Word in the Belt User's Vocabulary

You will not find "tensation" in any dictionary.

It is the property of Main Belting Company and was coined to describe a patented and exclusive process by which—

*Excessive stretch is removed from
LEVIATHAN and ANACONDA Belts*

A BELT that does not stretch at all is a dead belt—it lacks elasticity and resilience.

But most belts stretch too much.

Then they SLIP.

And a SLIPPING belt wastes power, cuts down production, wears out quickly, causes expensive shutdowns.

Being TENSATED, Leviathan and Anaconda Belts stretch just enough—never too much.

They slip less than any other belt.

* * *

These are revolutionary statements.

They mean that LEVIATHAN and ANACONDA Belts mark a great step forward in the science of belt making.

They are backed by the pledge of an institution which has been true to its word for more than a generation—

LEVIATHAN and ANACONDA Belts, subjected to our exclusive process of Tensation, stretch less, last longer and give better service than any other make or type of belt. If your experience fails to prove this, we will refund the purchase price, you being the sole judge.



We have prepared two interesting booklets on belting—

"Transmission Belts," and "Conveyor Belts." We shall be glad to mail either, or both, on request.

MAIN BELTING COMPANY, Philadelphia

New York

Boston

Chicago

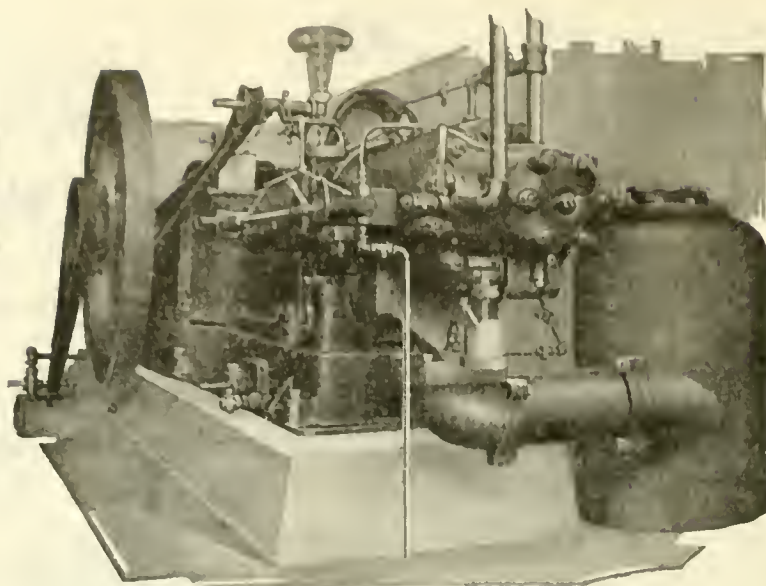
Pittsburgh

San Francisco

Leviathan AND Anaconda Belts

TENSATED TO REMOVE STRETCH

J. T. Mays & Bros., Spring Hope, N.C., operate this 50 h.p. Giant Semi-Diesel Oil Engine. Ask this user why he bought a "Giant," or ask us for the location of a Giant Engine installation near you.



Giants not only have the fundamentals of economy, low upkeep and long life, but meet every condition of service, no matter how severe or exacting, with either single or duplex types, in capacities from 12 to 200 h. p. Ask for Bulletin 389.

POWER

Additional Power—Replacement Power—Standby Power

Whether dignifying model-of-efficiency power plants or "roughing it" under adverse outdoor conditions, Giant Semi-Diesel Oil Engines can be *depended upon*. Whether installed as additional, replacement or standby power units, you can *rely upon* Giants. Simplicity, economy and certainty of operation are responsible for their wide endorsement by veteran engineers.

Replacement units must necessarily be the sum-total of what the unit they replace *isn't*. Its defects, inefficiencies and unreliability—whether in the form of broken heads, shaft breakage or hard starting due to loss of compression—must be overcome by its successor. Giants not only offset undesirable qualities of less efficient units, but in modern points of design they are unequalled.

Standby power has become as much of a necessity in the power field as *plant insurance*—because it stands between the plant operator and shutdowns by insuring a *constant* source of power supply. But only an oil engine of Giant dependability is eligible for this important guard-duty, a duty so well performed that Giants so installed have subsequently succeeded the "regulars."

Chicago Pneumatic Tool Company

Chicago Pneumatic Building • 6 East 44th Street • New York

Sales and Service Branches all over the World

*BIRMINGHAM	*CHICAGO	*DETROIT	FRANKLIN	*LOS ANGELES	*NEW YORK	RICHMOND	*SEATTLE	BARLE	BAUMGART	COPENHAGEN	HELENGFORS	*LONDON	MONTEVIDEO	PARIS	SANTIAGO	SHANGHAI	TORONTO
*BOSTON	*CINCINNATI	EL PASO	HOLSTON	*MINNEAPOLIS	*PHILADELPHIA	SALT LAKE CITY	*ST. LOUIS	*BERLIN	BUEENOS AIRES	*FRASERBURGH	HONOLULU	MANILA	*MONTREAL	RIO DE JANEIRO	SAO PAULO	TIENTSIN	VANCOUVER
*BUFFALO	*CLEVELAND	ELK	JOPLIN	*NEW ORLEANS	*PITTSBURGH	*SAN FRANCISCO		BOMBAY	CHRISTIANIA	HAVANA	JOHANNESBURG	MILAN	OSAKA	*ROTTERDAM	SEOUL	TOKYO	WINNIPEG

EN 47

BOYER PNEUMATIC HAMMERS • LITTLE GIANT PNEUMATIC AND ELECTRIC TOOLS
CHICAGO PNEUMATIC AIR COMPRESSORS • VACUUM PUMPS • PNEUMATIC HOISTS,
GIANT OIL AND GAS ENGINES • ROCK DRILLS • COAL DRILLS

GIANT

Dependable Power at



ENGINES

Less Cost Per Hour

Mining and Scientific Press

EDITORIAL STAFF

T. A. RICKARD, EDITOR
A. W. ALLEN }
A. B. PARSONS } ASSOCIATE EDITORS

Member Audit Bureau of Circulations
Member Associated Business Papers, Inc.

ESTABLISHED 1860

Published at 420 Market St., San Francisco,
by the Dewey Publishing Company

BUSINESS STAFF

C. T. HUTCHINSON, MANAGER
E. H. LESLIE, 600 FISHER BLDG., CHICAGO
F. A. WEIGLE, 31 NASSAU ST., NEW YORK

SCIENCE HAS NO ENEMY SAVE THE IGNORANT

Issued every Saturday

SAN FRANCISCO, JUNE 25, 1921

\$4 per Year—15 Cents per Copy

TABLE OF CONTENTS

EDITORIAL

	Page
NOTES	865
QUIET TIMES	867
Curtaiment of copper production. Conditions in Arizona and Montana. Inactivity at Butte. Local savings. Wage-cutting.	
THE OUTLOOK FOR DOMESTIC SILVER.....	867
Re-purchasing under the terms of the Pittman Act. Price of silver. Effect of the Act. Speculation by the producers. Repeal of the Pittman Act. Distribution of the output of silver. Silver in base-metal ores. Silver production in the future. Diminishing production, counterbalanced by entry of new producers. Time necessary to produce silver from base-metal ores. Continuation of the present price of silver under the Pittman Act.	

DISCUSSION

GOLD IN BLACK SAND	
By John Gross.....	869
A reply to a criticism of a recently published report. The meaning of 'black sand'. Classification and table concentration. The work at the Alaska station of the Bureau of Mines.	
REGENERATION OF CYANIDE DURING PRECIPITATION	
By A. W. Allen.....	870
The question of the regeneration of cyanide during passage of solution through zinc-box or press. An experience. The testing of solutions. Actual results. Method of correction. Comparison of results by different methods. Equations of probable reactions that occur.	
LEYNER DRILL	
By George E. Collins.....	871
First use of the Leyner drill. The Newhouse tunnel. A method of prospecting.	
SUSPENSION OF ASSESSMENT WORK	
By E. Hedburg	871
Opposition on the part of prospectors to legislation favoring extension of postponement of assessment work. Need to bring conditions to attention of Senators.	

COPPER MINING IN NEWFOUNDLAND

By T. E. Wells.....	872
Deposits of copper ore in Newfoundland. Peyton mine. Great Gull Lake Copper Co. Goldfield in White Bay. Failure of so many of the men in charge.	

COLORING OF GLASS

By W. H. Shockley.....	872
A suggestion that the violet color of glass may be due to manganese. Formulas for making glass.	

ARTICLES

THE NEW SURFACE-PLANT FOR THE UNITED VERDE COPPER COMPANY

By L. A. Parsons.....	873
Topography. Inadequacy of the old surface-plant. Factors affecting design of new plant. Comparative costs. Power-house and machine-shop. Blacksmith-shop. Change-house. Warehouse. Sewage disposal. Shaft design. Construction statistics.	

MANUFACTURE AND USES OF TUNGSTEN

By W. E. John.....	879
Source of tungsten. Method of recovery. Reduction of oxide. Electric furnace operation. Characteristics of the metal. The Pointolite lamp. Tungsten in golf balls.	

THE KANTISHNA MINING DISTRICT, ALASKA

By James A. Haney.....	881
Introduction. Power and fuel. Geology. Placers. Production. Future of placer mining in the Kantishna district.	

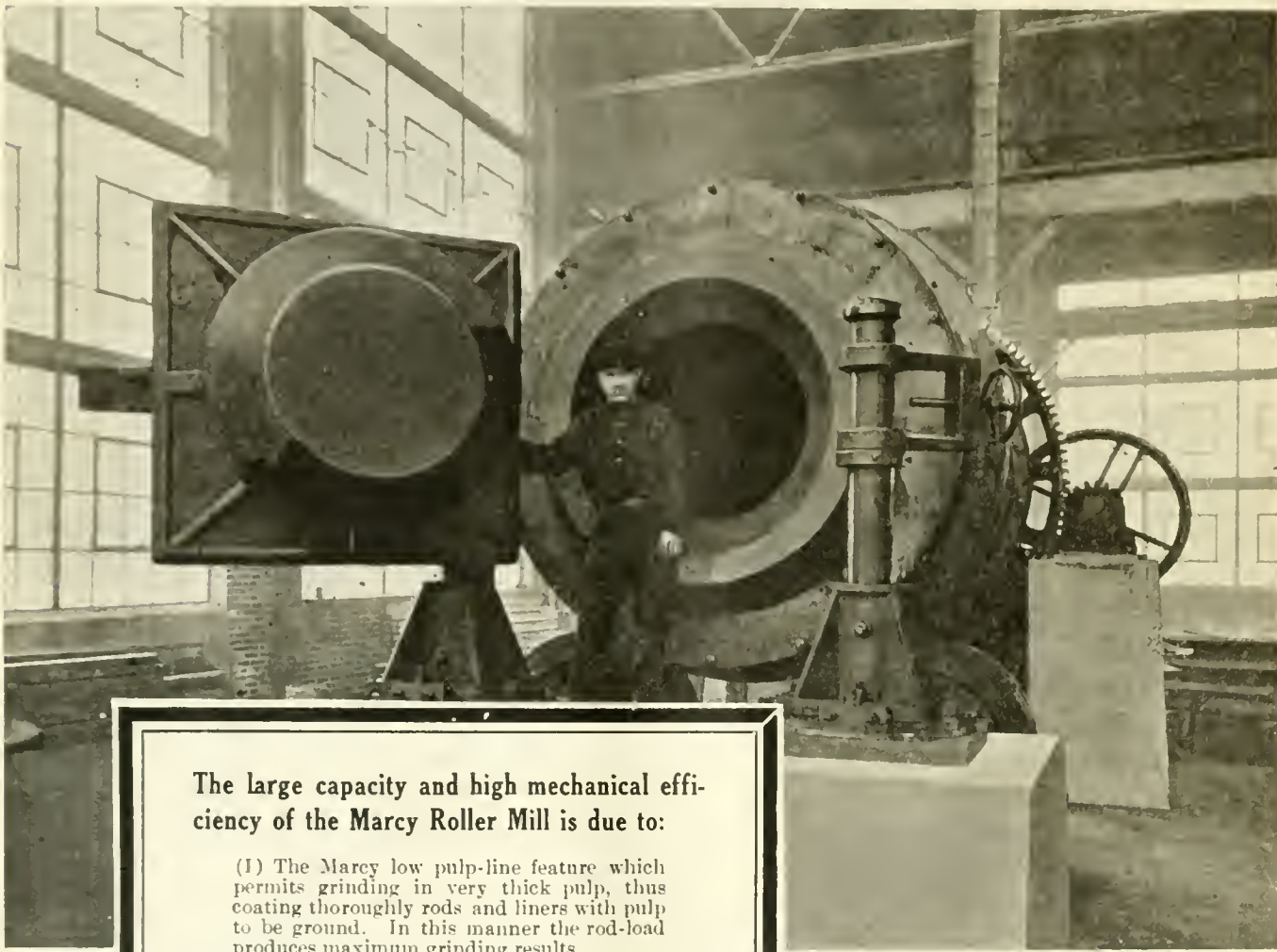
THE SILVER HORN DISTRICT, NEAR PIOCHE, NEVADA

By T. H. M. Crampton.....	883
Discovery of the property. Outcrop. Geology. Value of the ore. Officers of the company. Other mines in this district.	

DEPARTMENTS

REVIEW OF MINING	885
PERSONAL	892
THE METAL MARKET.....	893
EASTERN METAL MARKETS	894
INDUSTRIAL PROGRESS	895

Reasons for Marcy Roller Mill Success



The large capacity and high mechanical efficiency of the Marcy Roller Mill is due to:

(1) The Marcy low pulp-line feature which permits grinding in very thick pulp, thus coating thoroughly rods and liners with pulp to be ground. In this manner the rod-load produces maximum grinding results.

(2) Rods working on thin layers of thick pulp and the non-cushioning and non-buoyant effect of the pulp on the rod-load due to the low pulp line.

(3) The Marcy open-end feature permitting quick and easy inspection of the interior of the mill, providing an easy means for putting in and taking out rods and liners, thus keeping the grinding medium up to the highest efficiency.

(4) The use of cheap wearing parts and the low power consumption per ton of ore ground.

The Marcy Roller Mill is the only grinder of this type whose design embodies all of the above principles and this accounts for its instant success and its great efficiency.

Marcy Roller Mill Booklet Sent on Request

THE MINE AND SMELTER SUPPLY COMPANY

Denver

Salt Lake City

El Paso

New York Office, 42 Broadway

Chicago Representative:

J. R. Mougin,
4555 Malden Street, Chicago, Ill.

San Francisco Representative:

M. H. Carpenter,
3151 Eton Avenue, Berkeley, Cal.



T. A. RICKARD, Editor

WHAT trouble the Irish question can make is shown by the proceedings of the American Federation of Labor assembled in convention at Denver. It is a non-American question and it is deeply regretted that it should serve as a cause of discord among our own people, whether admirals or laborers.

SILVERHORN is a mining camp where there is a revival of activity in a part of Nevada heretofore best known through the fame of Pioche, where also, we are informed, there are signs of awakening. Within three months the census of Silverhorn grew from nothing to 300, and it promises to be able to boast 1000 inhabitants by the middle of summer. We thank Mr. T. H. M. Crampton for sending us the timely information in his article, which will be found on another page of this issue.

THE Senate resolution suspending assessment work on mining locations beyond July 1 has received an adverse vote in the committee of the House. This means that the assessment work for 1920 must be started before midnight of June 30 and pursued continuously until completed to prevent re-locations by other parties. The work for 1921, unless excused by further legislation, must be done before December 31 of this year. This is in accord with public opinion, especially among prospectors, as our columns have shown.

CONTRARY to sundry published reports, we learn from an authoritative source that the 10 million pounds of copper recently sold to the Pacific Gas & Electric Company netted the Anaconda Copper company 14 cents per pound for ingot metal. In other words, after the actual cost of passing the copper through the rod-mill and drawing it into wire, amounting to between 3 and 4 cents, has been subtracted from the selling-price, 14 cents remains. The particular metal that will be used to fill the order has been in the company's warehouse at Great Falls for many months; doubtless the mining, smelting, and refining cost fully 14 cents per pound. On the other hand, under the conditions existing at the present time, the Anaconda company could probably make a substantial profit by selling at 14 cents. Incidentally, it would be cheaper to send the wire to Seattle and ship it to San Francisco by boat than to transport it by rail for the entire distance; however, the new freight-rates

that were recently announced will equalize the cost, and the railroads will accordingly get the business. Delivery is to be made before September 1.

POLITICS is a dirty business most of the time, and when it becomes injected into an educational system it makes no end of trouble, as has been seen in the recent history of the Colorado School of Mines, whose reputation has been saved, not by anything done by its trustees or by the Legislature, but by the excellent records made by its graduates. We say this in order to give emphasis to our pleasure in announcing the acceptance by Mr. Stanley A. Easton of an appointment as a member of the State Board of Education and Board of Regents of the University of Idaho. The Dean of the School of Mines, Mr. Francis A. Thomson, writes to us to express his delight with the appointment, and we can well understand his feelings on the subject. The manager of the Bunker Hill is exactly the broad-minded clear-headed man to be a sagacious trustee for an educational establishment; himself a graduate from the University of California and a remarkably successful mining engineer, he has shown a wise humanity in his management of men and a keen response to everything that is progressive, not only in technical matters but in social institutions. The Governor of Idaho has set a good example to the executives of neighboring States.

ADDITION of another member to the President's Cabinet, to be known as the Secretary of Mines, is proposed in Senate bill 1957, introduced by Mr. Samuel D. Nicholson, the new Senator from Colorado. The function of the proposed department is "to encourage, protect, and promote the welfare of the mining and mineral industries", including "the coal, petroleum, and gas industries, all the metal mining industries, including iron and all the non metallic mining and quarrying industries whether of minerals or rocks". The Department, however, is not to "deal with metals or mineral products, nor with any problems pertaining thereto when they pass from the raw into the manufactured state". It is proposed to abolish the existing Bureau of Mines and the Geological Survey, and to create a Bureau of Mining Technology, a Bureau of Mining and Applied Geology, a Bureau of Mineral Markets, and a Bureau of Public Mineral Domain, together with sundry lesser "divisions". While we can see probable advantages to the

mining industry in the creation of a separate department and can recognize some merit in the proposed plan of organization, we do not believe that the measure is wise, for at least two reasons: first, the Cabinet is large enough as it is, and, second, the country is hoping, with varying degrees of confidence, that a complete reorganization of the executive branch of the Government will be effected shortly. The accomplishment of Senator Nicholson's plan would merely complicate the already perplexing task of re-arrangement; it should be made a part of the more comprehensive plan for reorganizing the entire administration at Washington.

JUDGE GARY'S comments at the recent meeting of the American Iron and Steel Institute shed a new light on the present economic situation. "There is nothing the matter with the country," he said, "it is with the individuals." Profiteering is being carried on alike by the seller and by the consumer. The seller's turnover is smaller than normal, so he maintains a high level of prices; the consumer postpones his purchasing and restricts his spending. In other words, says the chief spokesman for the U. S. Steel Corporation, the consumer tries to profiteer by not buying until there is a complete and, to him, satisfactory readjustment of price-levels; he is conducting a passive-resistance strike. The result of all this is that our economic system has been seriously injured; concessions must be made by all classes in the community. Wages must be lowered, but a fair and reasonable scale should be maintained; prices must be adjusted in proportion to cost of production. The public, which has suffered from the profiteering tactics of both labor and capital, will then aid in the restoration of prosperity by an increased interest in national welfare; it will help to turn the wheels of industry by judicious spending.

SUCCESS in all his relations with labor gives Mr. Henry Ford's remarks, in a recent issue of 'System', considerable weight. He takes as his text the truism that the employer should strive to understand his men; he must not make the mistake of thinking of them merely as units or as wage-earners, or as being different from himself; he must realize that they have the same desires and the same ambitions that he has. All of us want to succeed, and when the employer views his employees in this light he is courting efficiency. He begins to see that the success of his workman and the success of his business are tied together, and he will try to discover means that will help his men to succeed. A man who works with enthusiasm and interest will earn more for his employer than one who is indifferent and discouraged. Mr. Ford's advice to all employers of labor would be this: "Remember that your workmen are human beings; they have ambitions to succeed exactly as you have; give them a chance to serve their own interests in serving yours. Make them valuable to you by giving them a chance to become valuable to themselves." There must be some

logic in Mr. Ford's philosophy, for his company has weathered the industrial crisis without distress. In spite of rumors to the contrary, the work has been carried on, with only a comparatively short break, without borrowing; the output of machines last month reached a peak; and the prices, to the purchaser, are on the decline. It cannot be doubted that much of this success is due to the attitude adopted by the company toward its employees.

OVERTURES have been made by Mr. J. F. Callbreath, secretary of the American Mining Congress, to the president of the American Institute of Mining and Metallurgical Engineers with a view to a consolidation of the 'Journal' and the 'Magazine' respectively of those two organizations. We were aware of this fact two months ago; it is now announced officially, and it is interesting. Apparently neither publication is on a safe basis, owing to the high cost of paper and printing, and each may desire the support of the other. The proposal, we assume confidently, will be rejected by the Executive Committee of the Institute. The two organizations cover entirely different fields and their publications have little in common. To consolidate them would stultify both. The Congress essentially is a political organization, using 'political' in its honorable sense as covering public affairs, whereas the Institute is a professional society intended to promote the solidarity and contribute to the technical knowledge of those engaged in directing mining and metallurgical operations. The chief function of the Congress is to maintain a lobby at Washington in behalf of the mining industry, and it does this work admirably, thanks to the sagacity and energy of Mr. Callbreath, who is the key-man of the Congress. The chief function of the Institute is being subordinated to its publishing activities, which already have taxed its financial resources unduly. The Mining Congress 'Journal' has a reasonable excuse for its existence, because Mr. Callbreath has a considerable volume of legislative news to issue to the members of his organization. He might issue such news to them, as he does to the press, in mimeographed form, and thereby save the cost of much printing and of expensive paper, to which is added the additional expenditure incurred in the printing of pictures and piffle concerning various and sundry people of secondary importance. As a member of the Congress we feel entitled to say this much, but it is to be noted that the 'Journal' of the Congress does not deal with the technology of mining and metallurgy; it aims as much as possible, we are informed, to avoid trespassing upon the field so adequately covered by the technical press. The Institute 'Magazine' fails to observe this restraint and endeavors to compete commercially with the technical press, to which, incidentally, it owes its very origin, for the Institute made its start under the guidance of the first two editors of the 'Engineering and Mining Journal'. We refer, of course, to Rossiter W. Raymond and Richard P. Rothwell. It would make them turn in their graves to learn that there was such a thing as the Institute 'Magazine' and that it was now proposed to commercialize the energies of the

Institute further by a consolidation with the political publication issued at Washington.

Quiet Times

The curtailment of copper production, as might have been expected, has brought gloom to the mining districts of Arizona and Montana. At Miami, the Inspiration mine is shut-down, but the Miami company is producing, having a contract with the International smelter, near-by, but idle. About 8000 tons of concentrate already is stored in the smelter-yard and is covered by a shed to protect it from the wind. At the Calumet & Arizona a production of 500 tons daily is being made for a time, this output being bedded at the Douglas smelter. Operations at the New Cornelia are on a scale of 25% normal, and 1200 tons of ore is being produced daily. Two shovels are at work. At Bisbee the new mill of the Copper Queen is approaching completion and is said to do great credit to its designer, Mr. H. Kenyon Bureh. At many mines the interval of inactivity is being utilized for research, more particularly in the making of leaching experiments. At Butte it seems like Sunday all the week, but about 5000 men are obtaining part-time employment. The month is divided into three parts, so that three sets of men work ten shifts apiece. The Anaconda company is paying for 1850 shifts daily, including the staff. Before the War there were 14,000 men employed at Butte, and during the War the number increased to 18,000. The Anaconda reduction works gives employment to 3000 men in normal times; now only 300 are engaged. The only part of the plant that is active is the zinc concentrator, which is being operated at quarter capacity, equivalent to 400 tons daily. At the last census Anaconda had a population of 12,000. It was a thriving and thrifty community, and that is why the 'slump' has been met in such good spirit. The savings and current accounts in the local banks show that \$4,500,000 is on deposit. Needy cases are being assisted by the Red Cross and by the company "on the hill", but as yet no large measure of distress has developed. At Butte also, despite the months of near-idleness, the withdrawals from the savings banks are almost negligible. It is said that since Montana 'went dry', on January 1, 1919, there has been a marked increase of thrift among the workers. The population of Butte, including its suburbs, was never more than 60,000, and now it is about 50,000. Day's pay to the miner is \$4.75, a decrease of \$1 from the war-time rate. Contractors used to make \$7.50 to \$8 per shift. The second wage-cut, made in many mining districts, has been delayed by the shutting down of the Butte mines, but it may be anticipated that when full operations are resumed, wages will be on a lower scale. What work is being done now is mainly in the interest of the community. Most people are ready to believe that copper-mining centres like Butte are 'dead'; they seem somnolent, indeed, but there is a good deal of life, economic as well as social, to be seen, and, it is pleasant to add, there is a courage to face difficulties and a quiet confidence in the future of the industry.

The Outlook for Domestic Silver

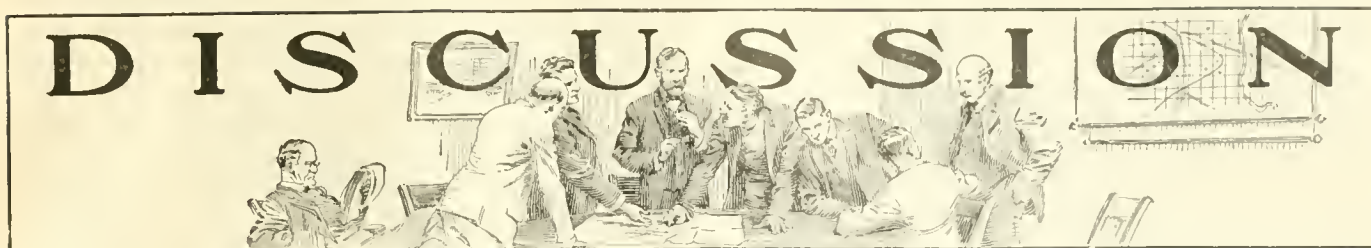
Just a year ago the Re-purchasing Clause of the Pittman Act became operative for the first time. The Act, passed in April 1918, consisted of two distinct parts: the first authorized the melting of silver dollars, then stored in the vaults of the Treasury, to meet a national emergency; the second pledged the Government to purchase newly mined domestic silver at \$1 per ounce, in amount equivalent to the total contained in the coins melted. The first provision probably kept the price of silver from soaring to an unprecedented height in 1918, and consequently was to the disadvantage of the miner; by way of compensation the second stipulation, manifestly favorable to the miner, was made; but it was specifically arranged that the Government should not lose a cent by the dual transaction. On June 7, 1920, the price of silver on the open market fell below \$1, and on the following day it collapsed to 84 cents; automatically the Government was confronted with its obligation to purchase metal offered at \$1 per ounce. The Director of the Mint, after a brief delay for formulating the affidavits of the miner, smelter, and refiner as to the domestic origin of the bullion offered for purchase, began to accept consignments. That was almost exactly a year ago. During the last twelve months the Director has received 58 out of 209 million ounces that must be purchased to replace the dollars melted in 1918. It is no exaggeration to say that the operation of the Pittman Act has preserved the mining industry of the United States; but for it many of the mines that are now producing lead and zinc ores rich in silver would be in the unfortunate position of the zinc mines whose ore contains little or no silver and of the copper mines that have suspended production entirely. The silver mines in which silver is the predominant metal likewise would have suffered seriously, although they are not as important a part of the mining industry as are the mines wherein silver, under normal market conditions, is a secondary product.

The producers of American silver, consciously or unconsciously, are speculating on the probable duration of the period of fixed price. Financiers in New York, and, as a corollary, politicians in Washington, have agitated for the repeal of the Pittman Act. Congressman Louis T. McFadden, the advocate of relief to the gold miner, even went so far as to introduce a bill with this purpose in view. However, the silver miner need have little apprehension concerning the fate of such legislation, for two reasons: such a repeal is undesirable from every point of view, not for the producers of silver alone but for the country at large, and accordingly is not likely to evoke appreciable support in Congress; and, even if it were supported, the Congressmen from at least six Western States are so emphatically opposed to it that they would defeat the measure by a filibuster, should it become necessary to resort to such tactics. The possibility of a repeal is too remote for serious consideration. It is conceivable that the price of silver in the open market might exceed \$1 per ounce; in that event purchases under the Pittman Act would

cease automatically, for the obvious reason that domestic producers would sell their bullion elsewhere than to the Mint. Some peculiar combination of economic forces may result in an excessive demand for silver, but so far as can be foreseen the foreign price will remain well below \$1 for several years. Excluding both of these contingencies, the question of the further operation of the Pittman Act then depends entirely upon the length of time that will elapse before the remaining 151 million ounces of silver will have been mined, smelted, refined, and delivered to the Mint. At the present time competent authorities estimate the rate of production to be not greater than 40 million ounces per annum; some say less than 35 millions. In 1920 the production was 56,555,560 ounces, 95% of which came from seven States. The following data show the approximate output from each, in millions of ounces: Montana 13.5, Utah 11.5, Idaho 7.5, Nevada 7.5, Arizona 6, Colorado 5.5, and California 1.5. Of Montana's production 7 million ounces came from the Anaconda company's copper ore, 1.2 millions from the other copper ores of Butte, and 1.8 millions from the Butte & Superior company's zinc ore. From none of these sources is there any production at present. Of the remainder, 2,000,000 ounces was derived from zinc-silver ores mined by the Anaconda company, 358,000 came from the Hibernia mine of the Davis-Daly company, and the remainder was divided between Senator Clark's Elm Orlu mine and some fifty small mines in the old silver districts adjacent to Helena. Even assuming an increase of activity in the outlying districts, it is apparent that Montana's production is dependent largely on the revival of the market for copper and zinc. In Utah the situation is different. During 1920 the Utah Copper Company produced only 257,000 ounces of silver, the high-grade lead-silver ores of Park City, Eureka, Bingham, and other districts accounting for at least 95% of the total output. One of the largest silver producers in the country during 1921 should be the Tintic Standard mine, situated north of the town of Eureka. The company recently has commenced operations at its new chloride-roasting and leaching plant for the treatment of the low-grade ores, and the gross output for 1921, including high-grade shipping ore, will probably exceed 3,000,000 ounces. A moderate production from Idaho is being maintained largely by virtue of the high silver content of the lead and lead-zinc ores of the Coeur d'Alene region, although the Callahan company has suspended production entirely. Except for the Nevada Consolidated at Ely, most of the Nevadan properties are typically silver mines; three-quarters of the output comes from a little group in the Tonopah district. Here output is temporarily stopped by a strike of miners and craftsmen; but, when the labor troubles have been adjusted, it may be expected that the West End, Tonopah Extension, and Tonopah-Belmont, each with an annual output of between one and two million ounces during 1920, will renew their steady flow of metal to the Mint. On the other hand, the Tonopah Mining Company, once leader of them all, has reserves for only five months,

according to a statement made by its officials. Arizona is like Montana except that it has no mines supplying high-grade zinc-silver ore to help in maintaining the production; all the copper mines are practically shut-down except the Miami, whose ore contains very little of the precious metals. Arizona therefore plays an inconspicuous part, for the time being, in maintaining the output of silver, although a revival of gold-silver mining in the district of which Kingman is the centre seems likely; this will offset to some extent the loss from the copper mines. The lessee seems to flourish in Colorado. Hundreds of shippers are sending small consignments to the smelter at Leadville, thereby augmenting the output recorded by the larger mining companies. Freight-rates have militated somewhat against shipments, but no great increase in the rate of production is to be expected. Most of California's 1,500,000 ounces comes from a remarkable little mine called the California Rand in the southern part of the State; from this property, high-grade ore averaging 100 ounces of silver per ton is being shipped regularly to the smelter at Selby, on San Francisco Bay; moreover, we understand that the erection of a mill is planned to concentrate the low-grade ore that has been developed during the past two years.

Ore-reserves do not perpetuate themselves, and when ore containing a million ounces of silver is taken from a mine there is that much less to stoep. The production of many thriving properties will diminish, or even cease, during the next two or three years. On the other hand, some small mines of today will grow into big ones to compensate in part at least for the diminishing production elsewhere. It is possible that one of our Silver Hills, or Broken Hills, or Silverhorns may develop into another Tonopah, but even so, it takes time to make big productive mines out of prospects. It is apparent that the most important factor in determining the duration of the Pittman Act is the time that will elapse before the markets for copper and zinc revive. However, we believe that the silver miners themselves join us in desiring an early termination of the prevailing general depression in base-metal mining, even if the result be a shortening of the period during which the Director of the Mint will purchase their silver at \$1 per ounce. Most of them prefer general prosperity even though it may seem contrary to their immediate interests. In analyzing the problem, the fact should not be overlooked that several months elapses from the time the copper or zinc ore is mined until the contained silver is ready for the market. This 'lag' between production and marketing operates both during the period when mines are shutting down and when mining is being resumed. Accordingly the result of the suspension of copper mining in April has not yet been reflected in the Mint statistics. On the other hand, it will be three or four months after production is resumed before the result will be noted in the increased production of refined silver. Everything considered, we feel safe in predicting that domestic silver will bring the producer \$1 per ounce for at least two and a half, and probably for three years.



Gold in Black Sand

The Editor:

Sir—In his communication on this subject, which appeared in your issue of May 14, Mr. Holmes evidently has been led astray by failure to realize that the statement of the results of certain tests made on heavy sands recovered in placer clean-ups in Alaska, to which he refers, was one of a series of similar tests that were undertaken for the purpose of devising, not an ideal means for the recovery of gold from such material, but some simple and easily applied method which would meet the conditions existing at the place where this material is produced.

The original report bore the title 'Recovery of Gold from Black Sand by Classifier Concentration', and gave the results of a test in which classifier concentration was employed. Any inference from this report that this method was regarded as an ideal method for the treatment of such material is altogether unwarranted.

Mr. Holmes is evidently not familiar with conditions existing in the interior of Alaska, and is therefore unaware that 'black sand' is a local term applied to any heavy sand recovered in a placer clean-up, regardless of whether or not it is black. As the investigation was made for the purpose of aiding local placer men in Alaska, it seemed warrantable to use a local term, even though it was susceptible of misconstruction.

The purpose of the investigation was not simply to recover the gold contained in this so-called 'black sand', but to ascertain some method whereby the placer miner could, without too much expense, either in the way of labor or additional equipment, make a better saving on this material. The Alaska placer miner does not entertain the same view as Mr. Holmes in regard to the great value of material containing 11 cents per pound in gold. It is true that the obvious inference from the preliminary determinations was that the gold was locked up in quartz and could be freed from it by grinding. However, the operators are not provided with grinding equipment, and while it would have been satisfactory to turn it over to a Chinaman for treatment, as suggested by Mr. Holmes, this method was unfortunately impracticable, because no Chinaman is to be found within a thousand miles of the place.

An elementary knowledge of transportation conditions in Alaska would suffice to indicate that shipping this material out for treatment would not produce a net return that would warrant taking the time to sack and ship it. The situation is very much like that of a farmer

who, having picked and prepared his apples for shipment, finds himself with a few bushels that are not of sufficiently good quality to warrant their shipment to market and yet which are too good to throw away. It is easy to point out that such fruit could be taken to a cider-mill and made into a liquid of interesting possibilities, but it is not worth the farmer's time to hitch up his team and take this material to the mill. He will probably do one of two things—either feed them to the pigs or leave them on the ground under the trees as material that, though possessing some value, is not worth the expenditure of further labor.

As regards the last table, I must plead guilty of contributory negligence in not having made it perfectly clear in the text that the assay of 0.73 oz. per ton of the canvas concentrate, represents an assay of that material after it had been amalgamated as described. The concentrate before amalgamation, of course, had a much higher gold content, as shown by the fact that bullion from this and the minus 6-mesh concentrate contained over 81% of all the gold in the original material. In other words, the table is misleading in that the terms used—concentrate and tailing—refer to the products of the classifier and canvas-table treatment, although the results given represent those products after amalgamation. The products shown in this table are really all waste materials, with the exception of the bullion.

The installation of grinding machinery at the placer mines of interior Alaska is at present not warranted, as operations are conducted on a small scale. It must be remembered that sand with a value of 11 cents per pound is not very attractive to the Alaskan placer miner. It was the object of these tests to recover as large an amount of the gold in as high a grade of concentrate as possible with apparatus that could be built at the mine. The operator is not interested in a method of treatment that he cannot duplicate. If the sand can be roughly concentrated in home-made apparatus (such as a classifier and canvas table for example) further work is justified on the concentrate, such as treatment by amalgamation.

In the test under discussion, by classification and canvas-table concentration, the concentrate produced amounted to 16.8% by weight of the original material* and contained 89.2% of the gold. The value of this concentrate was 55½ cents per pound, which the Alaskan placer miner can afford to amalgamate when he cannot afford to amalgamate 11-cent sand.

*These concentrates weighed 123½ lb. instead of 132½ lb. as given in the 'Mining and Scientific Press'.

Finally, it must be remembered that the sand work conducted at the Alaska station is with the definite view to gold recovery from sands that are now a waste product in interior Alaska, and that any treatment of such material must take into account the fact that only small amounts of 'black sand' are produced.

JOHN GROSS,

Metallurgist, Bureau of Mines.

Washington, May 31.

Regeneration of Cyanide During Precipitation

The Editor:

Sir—Mr. Algernon Del Mar's article in the issue of June 11 re-opens a matter of interest that caused me to trespass on the hospitality of your columns in 1913, when I expressed disagreement with the contention that free cyanide is regenerated during the passage of gold- or silver-bearing cyanide solution through zinc-box or press.

I took charge of a milling-in-cyanide and all-sliding plant in Africa in 1912 at a time when operations were disorganized by the circumstance that the precipitation of gold from the cyanide solution was very unsatisfactory. Being a newcomer I did not feel inclined to make sweeping changes without due consideration of local conditions. I was not in favor of the scheme of treatment. The ore was unusually rich in gold, and I considered that it should have been milled in alkaline water and efficiently amalgamated before being subjected to cyanide treatment. Other objections to commencing cyanide treatment in the battery were obvious, but I was in no position to alter the flow-sheet; all I could do was to concentrate my efforts on an attempt to reduce the amount of gold in the solution that was circulating.

I first found that diminution in the rate of flow through the zinc-boxes had no favorable effect; additional zinc surface also resulted in no appreciable reduction in the amount of gold in the tail solution. The boxes were packed and re-packed without an evidence of appreciable improvement. The trouble seemed to be in the solution: I therefore examined the records, but found that the amount of free cyanide in the inflowing solution was no less than it was when precipitation was satisfactory.

For some years previously I had come to several conclusions in connection with the testing of cyanide solutions: that Liebig's method of direct titration, with KI indicator, of a working solution containing zinc compounds was unreliable; that efficient solution control was an important factor in securing results; and that facilities and cleanliness were essential to accuracy. The last-mentioned conclusion may seem superfluous, but as a matter of fact I had found that neglect in this respect was common. I then looked into the question of how the cyanide control tests were being made, and found that the work was in the hands of a busy shift-boss, and that cleanliness of operation was impossible of achieve-

ment under the conditions that prevailed. The test for free cyanide was being made by the time-honored and world-wide method of measuring out a portion of the solution, adding a few drops of potassium iodide indicator, and then titrating direct with standard silver nitrate solution—the same method that Mr. Del Mar describes in his article. I had my suspicions that the estimation was in error, and I fixed up a separate laboratory where it would be possible to carry out testing work under proper conditions and in anticipation of some degree of accuracy of result. A complete series of tests was then made, disregarding the usual method, and estimating total cyanide (using alkaline potassium iodide indicator), protective alkalinity (using Green's method, with phenolphthalein indicator), and free cyanide (using neutral potassium iodide indicator, after the neutralization of the protective alkalinity as indicated by the previous test). A further analysis of the solution showed an abnormally high amount of zinc and some copper. The outstanding feature of the result was the fact that the amount of free cyanide present was shown to be far below the amount indicated by the routine tests made at the works; there was insufficient free cyanide to ensure effective precipitation of the gold. This, coupled with the high zinc content, was evidently the cause of the trouble. The ordinary test resulted in the inclusion of a proportion of double cyanide that varied in amount with the degree of alkalinity, this amount of double cyanide being reported as free cyanide.

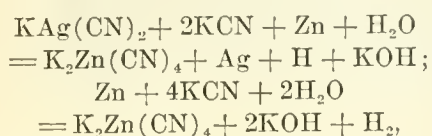
The trouble was eventually overcome by a temporary raise in the actual free cyanide strength of the solution entering the zinc-boxes, to ensure complete or nearly complete precipitation, followed by the daily discharge of a small amount of barren solution with the residue—to decrease the amount of zinc in the solution and to permit the resumption of a normally low free-cyanide strength throughout the plant. I then wrote an article on the subject, which you were good enough to publish in the issue of September 20, 1913, in which I attacked the ordinary method for the estimation of free cyanide. I mentioned that, with an excess of free cyanide and a moderate alkalinity in the solution entering the zinc-boxes, this method will indicate more free cyanide at the tail than at the head of the box. In other words, the solution will appear to have a higher efficiency after the formation of more potassium- or sodium-zinc cyanide! I cited the fact as an evidence of the absurdity of this method of testing, showing that ultimate fouling of solutions may be entirely due to the addition of zinc as a concomitant of precipitation. I also gave the following figures of actual titration results of a normal solution entering and leaving the zinc-boxes:

	Incoming, %	Outgoing, %
Total cyanide	0.175	0.175
Free cyanide:		
Direct titration after addition of KI indicator, by usual method	0.145	0.150
Titration after neutralization of protective alkalinity as estimated by Green's method.....	0.120	0.095

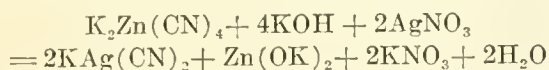
The article in question elicited a generous measure of criticism, most of which, unfortunately, was irrelevant.

Its publication served one good purpose, however, and that was to bring to daylight a method of testing devised by E. M. Hamilton, and since adopted to a wider extent as a direct result of the attention drawn to it.

In all cases, both before and after my South African experience, I have been convinced of the inaccuracy of the ordinary test as a means of estimating free cyanide in the presence of zinc compounds; my impression is—and I am willing to admit that others, including Mr. Del Mar, may hold opposite views—that no appreciable amount of free cyanide can be regenerated during the precipitation of gold and silver by zinc; an indication that such is the case is, in my opinion, an indication that the method of testing is at fault, the apparent increase being due to the higher alkalinity resulting from the precipitation of the metal and the dissolution of zinc, thus:



and the action of the silver nitrate on the double cyanide, in the presence of this additional alkali, thus:



San Francisco, June 11.

A. W. ALLEN.

Leyner Drill

The Editor:

Sir—I venture to submit brief remarks concerning two points raised in your issue of May 28.

(1) In your editorial on Mr. Brunton it is stated that the Leyner drill first came into prominence in the driving of the Roosevelt adit. This is hardly correct: it had been most successfully used, and had become widely known, in the driving of the Newhouse and other adits around Idaho Springs several years before. In fact, the Leyner drill was virtually a product of the Newhouse tunnel; new patterns were successively tried out there, often following suggestions made by the Tunnel staff, and especially by S. A. Knowles, who was for many years in charge of work in the heading.

I think the Leyner drill was one principal cause of the very low costs of driving the Newhouse tunnel in 1906 and 1907: costs which I think have never been equaled under comparable conditions. Another cause was the system of drilling the round with a bar, set up across the muck-pile, a system which, so far as I know, was first used at the Newhouse tunnel, and which was rendered possible by the Leyner drill.

The illustrations of Roman and Phoenician objects found in workings at Rio Tinto, which accompany your interview with Mr. Brunton, remind me that, when a boy, I received in change, in the plaza at Rio Tinto, a bronze Roman coin, still in circulation! I do not guarantee that it had been in circulation ever since the days of the Roman Emperors. Probably it had been found in a hoard of some kind.

(2) Mr. Knapp's description of a method of prospecting, for surface pockets of gold, is interesting and clear. But I do not think it is correct to say that it was first developed in the foot-hill counties of California. In 1898 and 1899 I assisted an old colored prospector in finding a surface pocket, using this very method, in White county, Georgia. He dug out and I panned two or three hundred dollars' worth of gold in one day—which, by the way, completely exhausted the find. The old colored man informed me that he had been taught this method of prospecting by his father, and that it was commonly used in North Georgia before the (Civil) War.

GEORGE E. COLLINS.

Denver, Colorado, June 6.

Suspension of Assessment Work

The Editor:

Sir—The following request was sent to Senators and Representatives of Arizona, at Washington:

"Hon. Dear Sir:

"The Prospectors and Miners of Mohave county, Arizona, are unanimously opposed to any legislation pertaining to the postponement of annual assessment work, on mining claims, for the following reasons: Work for 1920 is already done, and work for 1921 is now in operation. Suspension of assessment causes hardship on the prospector that depends on that kind of work for a living, and grubstake to do his own work with. Now that most of the big mines are closed down, miners need this work; it retards mining development, which is now at a low ebb. It can benefit the non-resident slacker only, the suspension has already done much harm to the legitimate prospector. Kindly fight against any attempts at new regulations."

Engineers, miners, and prospectors that depend on the mining industry for a living should write their Congressmen and Senators protesting against any new rules, and let us see if we can't break up that clique trying to hold the public domain without doing the work. Already we have had four years of suspension, let us stop to think what that meant to the prospectors: let us say 40,000 mining claims were subject to suspension, at \$100 each that means \$4,000,000 a year, and for 1920 alone, or \$16,000,000 in all. Of course, we can excuse the war period. Now this money has been lost to both the prospector and the mining industry in general. Is there any wonder that the prospector is becoming extinct?

To illustrate the working of the annual suspension regulation: in the month of December 1920 the writer and others started in to do the assessment work on a number of claims for an Eastern company, for the year of 1920, as usual, before the suspension bill was signed, and we had got about one-half claim done when a wire arrived that President Wilson had signed the bill, so the agent representing the Eastern company came out next morning and told us to stop work.

Again, I personally know of several good mining claims held by outsiders that would be in the hands of respon-

sible men now and be working right along if the ground had become open in January 1920, as it ought to have been, but, No, it is yet held at least till July 2, 1921, if no other suspension intervenes. We all know that there is another set of prospectors regulations now pending before the Congress, so let us all stick together and try to have the bill defeated before it gets any further. I understand that the clique forced President Wilson to sign the last suspension bill at the last minute, but that I am sure won't work with the President this time.

Kingman, Arizona, June 8.

E. HEDBERG.

Copper Mining in Newfoundland

The Editor:

Sir—In looking through your issue of February 12, I was pleased to notice the following item: "Rumors of a sale of four hundred million pounds of American copper to foreign consumers, principally Germany, by the Copper Producers Association have been insistent in New York". The financing of this deal involves an outlay, it is said, of forty million dollars. This certainly looks encouraging for the copper-mining industry. I am also in receipt of information that the copper people have it figured out that there is but 16 years supply of copper at the normal rate of consumption in all the known deposits of the world, against 500 years of coal, and like comparison with other minerals.

The great so-called American deposits rated at 24% copper are now proved to be but 1.75%. If this be so, 'Ye Ancient Colony' will come into her own in the year of our Lord 1937. Then, the large deposits that are now known to exist in the Great Bay of Notre Dame, such as the famous Tilt Cove mine, the Little Bay mine, the latter with good 6% ore at 1400 ft. deep, with little or no prospecting done either on the strike of the ore, or on the foot or hanging walls. The South West Arm deposits are rich in copper, assays from vein-matter have given as high as 30% copper. Some years ago, several hundreds of tons was taken from one deposit that averaged over 18%. The sterling Peyton deposit at Hall's Bay, a valuable property, the Sunday Cove Island property, and the Roberts' Arm deposit, and last, but by no means least, the Mother Lode mine, 14 miles inland from Hall's Bay, and which is known to prospectors as the Great Gull Lake deposit, the ore of which is chalcopyrite, and is shown on the surface for over five miles east and west. The Great Gull Lake Copper Co. owns 16 claims, or locations, of one mile by a half-mile each, or, in other words, eight square miles of this great orebody. They have done considerable prospecting and development work on the property, and have opened up two of their claims by sinking shafts and cross-cutting. They have sunk 60 ft. on one claim, and cross-cut 75 ft., all in ore averaging 2.78% copper. On another of their claims they have sunk 45 ft. and have cross-cut 30 ft.; at this shaft the vein-matter gave assays at different depths of 9%, 12%, and 15% copper, the whole averaging about 5%, but the owners have not ascertained the full width

of the orebody, at either of the shafts, as the ore in the breast of the crosscut is still good, and from surface showings the owners have every reason to believe that the orebody is considerably wider, and from surface indications on one claim it is over 1500 ft. in length east and west. On another part of the property there is a number of large and small boulders of copper-bearing rock, hundreds of tons in some pieces. Assays of samples taken from these pieces show 7.25% of copper with traces of gold.

And what about our goldfield on White Bay, when some few years ago a toy mill was erected and run by men who know something about copper mining, but absolutely nothing about gold mining or milling. Of course, it was a commercial failure. Why not? The employers put pieces of quartz in the crusher with visible gold in it, but after passing through the mill it was never seen again, and sights of free gold can be taken from the surface on other parts of the property, as well as in the shaft. It's a crime the way mining in this country has been butchered, and money flung away, so to speak, in the prospecting as well as in the actual mining, or working of the different deposits, by those who were sent here to look after their company's interest. Some were good capable men, but like every other good thing, were hard to keep; others were incompetent, and the only thing they seemed to be capable of looking after was their \$200 or \$300 per month, and when they had to leave for the Sunny South, they did their 'bit' to prevent capitalists from becoming interested in mining in this country. They are like the poor—always with us, but unlike the poor they do more harm than good.

T. E. WELLS,

President of the

Great Gull Lake Copper Co., Ltd.

Little Bay, Newfoundland, June 4.

Coloring of Glass

The Editor:

Sir—Answering the query of Francis Drake, in your issue of June 11, page 806: I have often seen violet-colored glass by the roadside in Nevada and elsewhere, and have assumed that the coloring was due to manganese. Here are a couple of formulas for glass-making that show manganese as an ingredient:

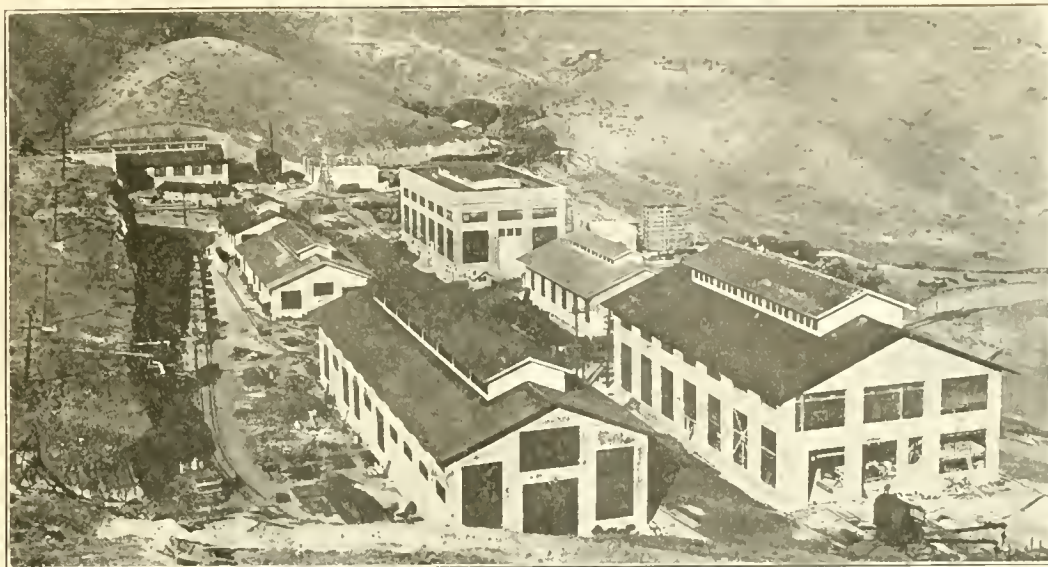
(1) 110 lb. quartz; 55 lb. potash; 22 lb. chalk; 1.5 lb. saltpetre; 1.5 lb. arsenious acid; 0.75 oz. pyrolusite.

(2) Pure silicious sand, 63 parts; potash, 22 parts; lime, 12 parts; oxide of manganese, 1 part.

Palo Alto, June 12.

W. H. SHOCKLEY.

THE general belief that the ancients were able to harden or temper copper to a greater extent than is now possible is a myth, in the opinion of the U. S. Geological Survey. Specimens of ancient so-called 'tempered' copper that have been examined have proved to be no harder than copper that is manufactured today, or to be simply an alloy of copper and some other metal.



THE NEW PLANT AS COMPLETED

The New Surface-Plant for the United Verde Copper Company

By L. A. Parsons

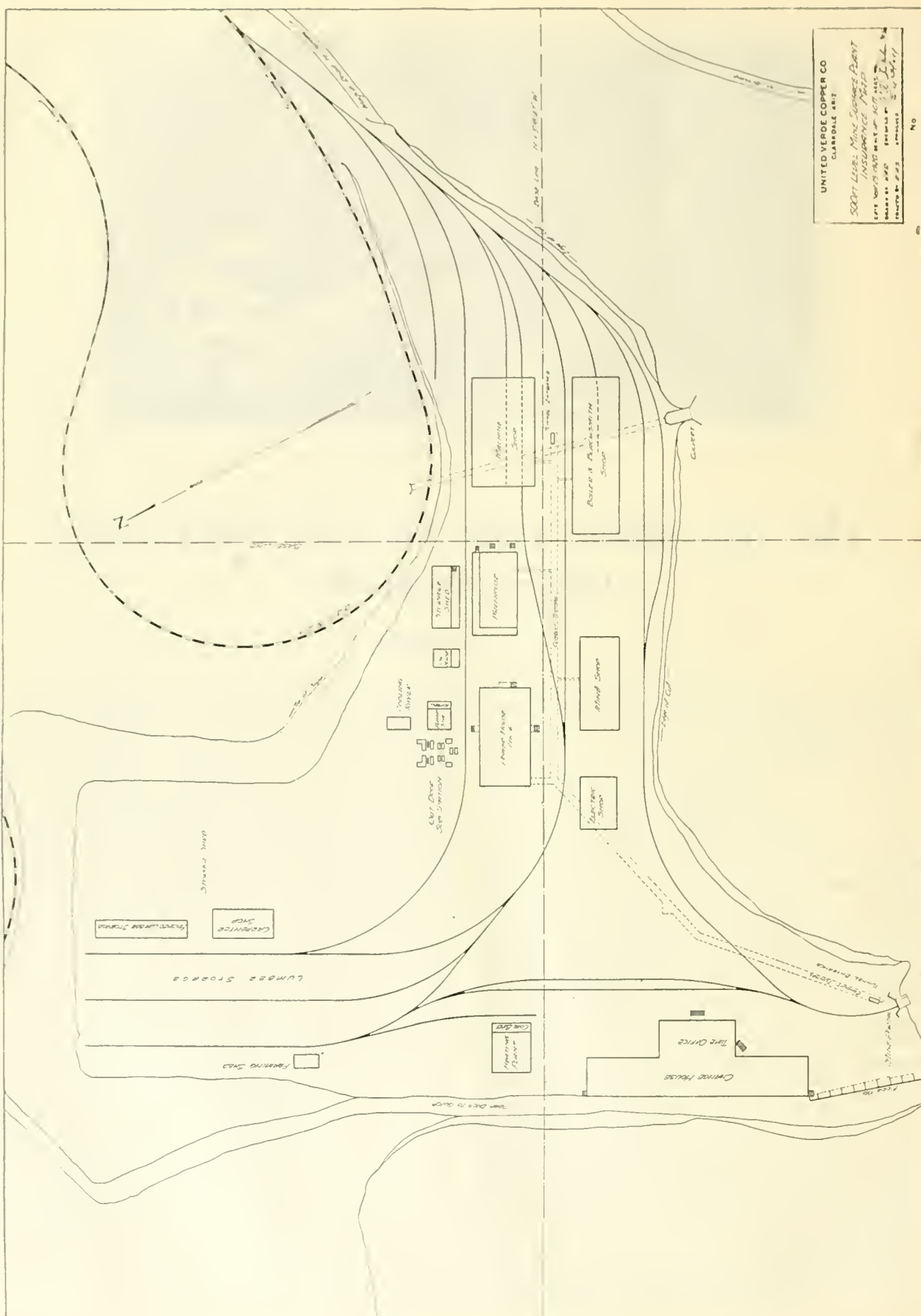
The present surface of the United Verde mine is on the eastern flank of the Black Hills, Arizona, at an elevation of approximately 5500 ft. The hillside is steep, dropping abruptly from the peak of the mountains, at an elevation of 7000 ft., to the Verde valley 3500 ft. below. Practically the entire terrain slopes so steeply that the erection of buildings is rendered exceedingly difficult. Natural horizontal areas are small and so scattered as to be almost useless for the purpose of construction. The town of Jerome adjoins the mine, but is in great part not owned by the company and is outside its direct control.

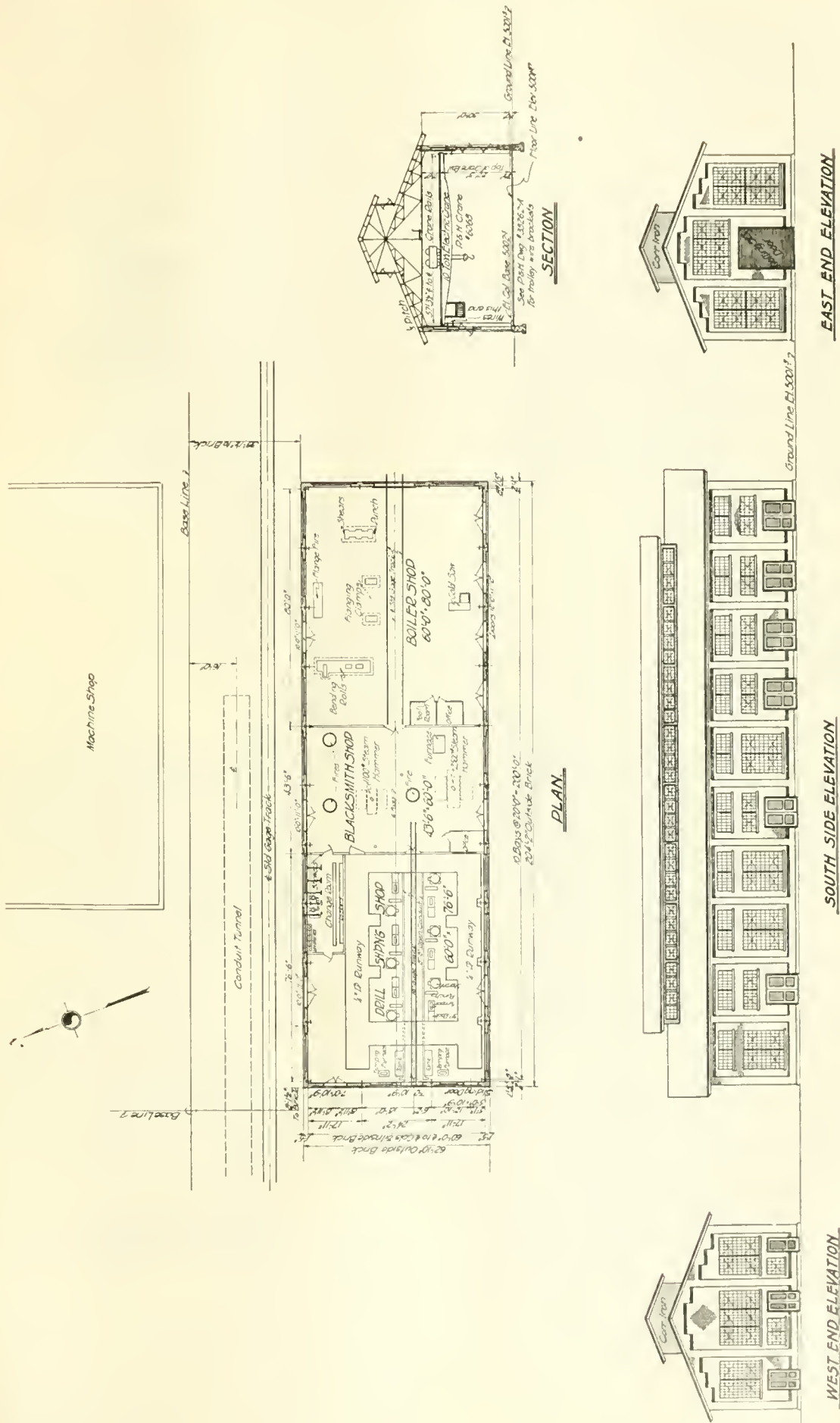
When the growth of the enterprise, together with certain changes in the mining methods, rendered the old surface-plant inadequate, and the housing of most of the employees in Jerome became increasingly unsatisfactory, the problem of building a modern surface-plant and of providing the employees with comfortable and attractive living quarters was not easy of solution. It was finally decided to 'make' ground on the hillside at the 500-ft. level of the mine, which is somewhat below the greater part of Jerome, to build the new surface-plant on the space thus provided, and to add gradually a modern town-site for employees adjoining the surface-plant. Entrance to the mine would be obtained by an adit connecting with an underground shaft (No. 6) for handling men and supplies.

The principal factors affecting the design of the plant were as follows: (1) An entire new plant was necessary, as the old one was not only unequal to the increasing de-

mands upon it, but the plans for mining the old fire-stopes of the mine by steam-shovel involved the excavation of much of the old site. (2) The plant must be capable of handling all the repairs and current construction work arising from the mining of 3000 tons per day underground, the operation of five steam-shovels on the surface, and the operation of the Verde Tunnel & Smelter railroad, connecting the mine with Clarkdale. (3) Space must be economized and yet room should be left for normal expansion. (4) Special attention must be paid to drainage, on account of the sloping ground. (5) Much of the ground being 'made', foundations for heavy machinery would require special work. (6) As the collars of the shafts were 500 ft. above, means of access to the mine needed to be provided for men, supplies, and repairs. (7) Weather conditions include strong winds; a high summer temperature, occasionally reaching 100° in the shade; light frosts in winter; and a small annual rainfall, but with occasional storms lasting two or three days.

Early in the design, comparative estimates showed that because of the increase in the price of steel, structures built of corrugated iron and steel would cost as much as those built of brick and steel. Consequently, the latter method of construction was adopted, resulting in buildings of unusual attractiveness and durability. Considerable care was taken to make them as attractive as possible in appearance, and, as can be seen from Fig. 2 and Fig. 3, the completed structures suggest far more those usually found in cities than at mines.





The power house, machine-shop, and boiler blacksmith shop are all self-supporting steel structures. The face-bricks were furnished by the New Mexico Firebrick Co., of Gallup, New Mexico, and the common brick by the Los Angeles Brick Co. The walls on all buildings are 17 in. at the pilasters, and 13 in. between. All the other buildings have steel roof trusses resting on brick walls. Concrete for foundations was a 1:3:6 mixture, and for floors 1:2½:5, reinforced by Clinton welded wire and some triangle mesh. Lupton steel sashes were used throughout, furnished by David Lupton Sons Co. The purlins are 8 in. channels with a 4-in. by 4-in. nailing-strip bolted in. All roofs except for the power-house and time-office are ¼-pitch, and are made by nailing 1½-in. tongue-and-groove sheathing to the purlins, and covering this with red 'flaterete' concrete tile made on the spot. The roofs of the power-house and time-office slope one inch in 12, and are made of a 2½-in. concrete slab on Hyrib reinforcing, covered with Johns-Manville roofing-felt, asphalt, and red 'Regal' roof-paint.

The details of construction and equipment of some of the more important buildings and accessories are as follows:

POWER-HOUSE. This is built on bedrock, so there was no trouble with foundations for structure or machinery. The equipment includes one 6800-cu. ft. Ingersoll-Rögler compressor (\$45,000 f.o.b. factory), one 1500-cu. ft. and one 3000-cu. ft. Ingersoll-Rand compressor from the old plant, and one 20-ton 3-motor electric traveling-crane. Two 500-kw. motor-generator sets are situated in the No. 6 hoist-station. The cooling-tower is 18 by 30, furnished by C. F. Braun & Co., San Francisco (\$3600 f.o.b. San Francisco). The air receivers are three old Parker boilers in the basement. Air is taken through a 16-in. line through the adit to a receiver at No. 6 shaft, thence by a 12-in. line down the shaft for distribution through the mine. The sub-station equipment includes four transformers and a 16-panel Westinghouse switchboard. The power-line from Hopewell is No. 4 B. & S. 7-strand hard-drawn copper cable, transmitting current at 44,000 volts. The pump-house is equipped with three 6-in. Cameron centrifugal direct-connected pumps, for the circulating jacket-water. A purifier and water-filter is used, manufactured by Wm. F. Scarfe & Sons Co., of Pittsburgh.

The machine-shop and boiler-blacksmith shop are on filled ground; hence the foundations required special work. Excavations for the column-piers were carried to bedrock and filled with concrete. Some of these holes were dug 25 ft. below grade-line before reaching solid footing. Reinforced concrete girders spanned between the column-piers to carry the brickwork. Machines were set on spread concrete footings, reinforced with scrap-iron, to distribute bearing on the fill. The fill had been in 16 months when the machines were set.

MACHINE-SHOP. This is equipped as follows. Many of the small machines were obtained from the shop at the old surface-plant.

- One 25-ton 3-motor electric crane.
- One 5-ton electric crane.

One convertible locomotive hoist manufactured by the Whiting Foundry Equipment Co. This consists of six jacks each with a capacity of 50 tons, the whole driven by a 50-hp. motor.

One 90 in. driving-wheel lathe, manufactured by the Niles Tool Works Co. The distance between face-plates is adjustable from 6 ft. 6 in. to 9 ft. 2 in. This is used principally for turning locomotive-drivers.

One 24-in. slotter, manufactured by the Niles Bement Pond Co.

One 26-in. by 12-ft. engine lathe.

One 36-in. by 16-ft. engine lathe.

One 42-in. by 42-in. by 12-ft. planer. These three were all made by the Niles Bement Pond Co.

One 36-in. by 44-in. side-head boring-mill, manufactured by the Niles Tool Works Co.

One 6-ft. radial drill-press.

One 100-ton hydrostatic press.

One 17-in. by 8-ft. LeBlond lathe.

One 3½-ft. radial drill-press.

One small drill-press.

One 28-in. shaper.

One 15-in. shaper.

One No. 3 milling-machine.

One 14-in. small lathe.

One abrasive-surface grinder.

One sensitive drill-press.

One drill-grinder.

One hack-saw.

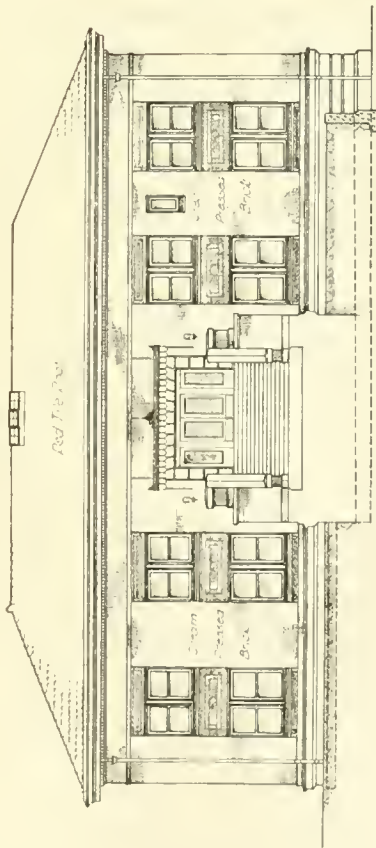
Two emery-wheels.

BLACKSMITH-SHOP. The steel-sharpening equipment includes six batteries of sharpeners with the necessary punches and furnaces. The steel after being sharpened is carried over a steel-sheeted runway in cars with flangeless wheels to the end of the shop, where it is tempered in two furnaces and placed in racks for use in the mine as wanted. The steel will be carried both to and from the mine in specially built narrow-gauge cars. The boiler-shop contains one 1100-lb. steam-hammer and one 2500-lb. steam-hammer.

CHANGE-HOUSE. This is designed to accommodate 1400 men in addition to the foremen and shift-bosses. The clothes are hoisted up by overhead pulleys and flexible wire-rope. Each seat has a small individual locker for small articles. This is not hoisted with the clothes. In addition, each shop-building has an individual change-room, equipped with shower-baths, lavatories, and steel lockers. The time-office is attached to the main change-house.

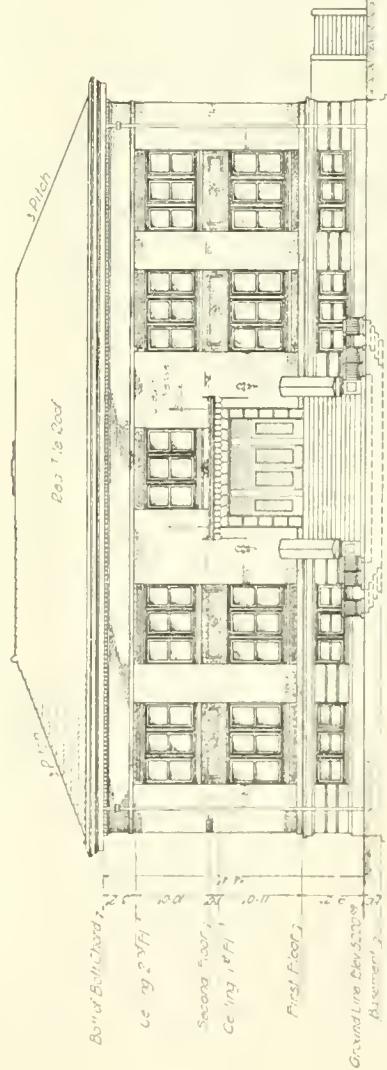
WAREHOUSE. This has a basement, main floor, and balcony floor, a total of 17,000 sq. ft. of storage space. The shelving and lockers are of steel. The elevator is an Otis electric.

In addition to the buildings shown in the plan there is, opposite the warehouse on the warehouse-track, a storage shed for cement and other heavy material and an oil and gasoline storage. Concrete platforms on the track side of the warehouse and of these storage buildings are 8 ft. wide. All standard and narrow-gauge tracks are so



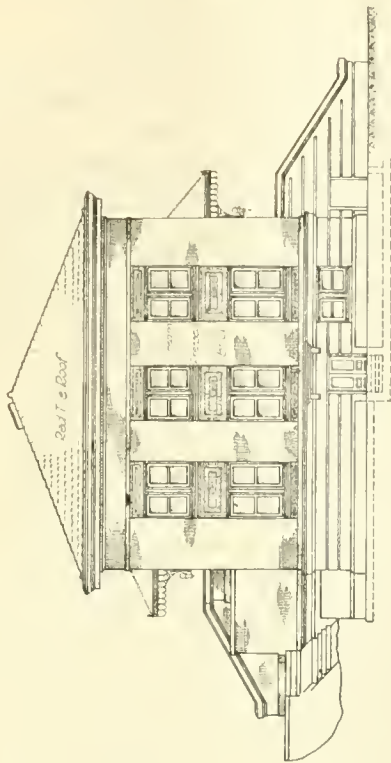
Note:
South - 1st Floor - 40' 11" x 21' 11" Check Rail
" 2nd " - 40' 0" x 21' 11"

East Elevation

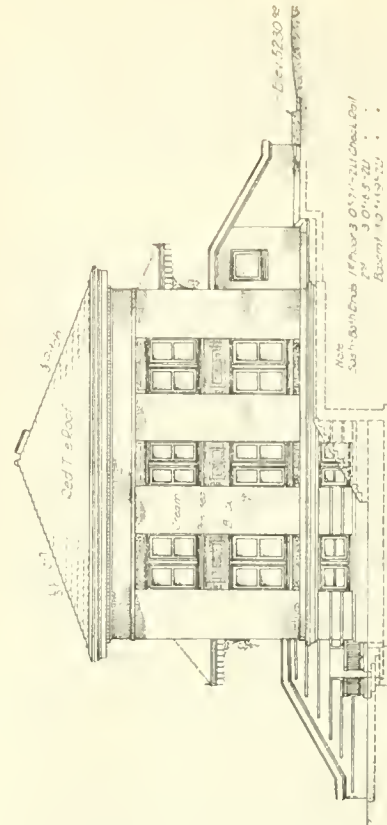


Note:
South - 1st Floor - 40' 11" x 21' 11" Check Rail
" 2nd " - 40' 0" x 21' 11"
" Basement 30' 0" x 21' 11"

West Elevation



North Elevation



Note:
South - 1st Floor - 40' 11" x 21' 11" Check Rail
" 2nd " - 40' 0" x 21' 11"
" Basement 30' 0" x 21' 11"

South Elevation

GENERAL MINE OFFICES

arranged that material can be transferred easily from one shop to another. All standard-gauge rails are 75-lb.

All steam-piping, water-lines, electric lines for both lighting and power, and air-lines are carried in a two-compartment conduit-tunnel with concrete service-boxes from the tunnel to each shop. The heating system is vacuum return-steam.

Sewage is carried to a 10-in. main sewer-line in a trench under the conduit, and thence down the hill to septic tanks. These tanks will also handle the sewage from the new townsite, which will be built adjoining the surface plant. When completed this will contain about 500 standard brick or hollow-tile dwellings, with stores, theatres, schools, and community centres. The streets will be graded and the sidewalks built of concrete. One hundred houses are to be built immediately. All will be fireproof, and will have baths, toilets, and sleeping-porches. A new road will be opened from Jerome through the new townsite, connecting with the present road from Hopewell to Clarkdale.

The hillside is trenched above the site to carry all surface water to culverts under the fill, which empty the water down the gulch. Mine-water from the adit empties into the sewer system.

The adit from the portal to the underground shaft (No. 6) is 1648 ft. long. It is 500 ft. from the sub-station to the portal. Men will be carried to the shaft in specially designed cars. Each car holds 26 men, and 10 cars are coupled together to form one train, thus carrying 260 men each trip.

The shaft is 13 ft. by 13 ft., and has one main compartment 8 ft. by 13 ft., in which operates a double-deck cage carrying 50 men on each deck, balanced by counterweight. The other compartment contains the manway, counterweight, and pipe-lines. The cage was made big enough and so designed that it can hoist the electric locomotive, thus obviating repairs underground. The cage-hoist is driven by a 350-hp. motor.

Table I gives some statistics on the construction. The steel was furnished by the Kansas City Structural Steel

engineer for the United Verde company, and under the supervision of C. M. Hoffman, superintendent of machinery.

In a paper recently read before the Institution of Mining & Metallurgy on 'Notes and Records of Mining Costs', A. E. Pettit stated that the zenith of efficiency on the Rand was probably reached about 1909. At that time the white labor was picked from a cosmopolitan group of miners and mechanics from all over the world, whose capability could not be excelled. The strike of that year robbed the field of many of the older men who were not parties to Union control, and led to a dilution of labor and the introduction of new fetters of trade unionism which diminished efficiency; and although by reason of the greater tonnage crushed the working costs did not show an immediate increase, expenses increased on account of the gradual growth of the inefficiency which today is so prominent. The crisis in white labor became acute in 1920. The number of men employed under trades-union regulation, and the inefficiency of this labor, caused costs to rise to such an extent that in spite of the premium on gold, it appeared inevitable that some of the lower-grade mines would have to close down. Conferences were, however, arranged between management and men, with a result that the number of white men was reduced and their efficiency increased. Wages were arranged on a grade-tonnage scheme, with the result that not only was the tonnage increased, but the grade was more than maintained. The following summary shows the results obtained at the Simmer and Jack mine:

	January 1920	June 1920	July 1920
Number of tons crushed.....	46,100	60,100	61,600
Mill grade (dwt.).....	4.926	5.730	5.608
Europeans at work.....	571	524	525
Tons per man.....	80.7	114.7	117.3

The gold recovered from silicious ore and tailing in California in 1919, according to the U. S. Geological Survey, was as follows: By amalgamation, 308,638 oz.;

Table I

Name	Excavation, cu. yd.	Concrete, cu. yd.	Reinforcing- steel, tons	Struct'l steel, tons	Brick, thousands	Steel sash, sq. ft.	Roofing, squares	Lumber, M board ft.
Warehouse	375	550	9	78	90	1,841	90	20
Power-house	2,100	575	4	148	240	7,377	85	18
Change-house and time-office.....	2,000	1,095	24	85	270	8,374	245	50
Machine-shop	500	350	5	172	240	7,250	170	36
Blacksmith- and boiler-shop	300	230	4	156	225	6,610	172	37
Conduit tunnel	3,500	990	7	...	...	...	...	...
Mine-shop	200	215	..	36	100	2,115	90	20
Electric shop	70	55	..	26	61	1,300	50	12
Heating-plant	220	200	3	13	84	1,150	27	..
Storage-shed	210	230	4	20	50	310	26	..
Oil-house	85	110	1	10	23	1,300	11	..
Assay office	500	165	..	15	65	...	50 tile	26
General office	500	365	..	39	120	...	60 tile	50
Bucking-room	50	40	..	4	23	...	12 tile	5
Total	10,610	5,170	61	802	1,594	32,505		268

Co., and after being fabricated in their shops was erected by their own men. The clearing of the site was done by the Twohy Bros. Construction Co. The United Verde company maintained a construction camp and boarding-house for the men employed on construction, charging \$1.25 per day for board, and furnishing a room free. The entire work was in charge of E. A. Hoff, construction

by cyanidation, 43,099 oz., a large part of which was from the treatment of concentrates; from concentrates and ore sent to smelters, 67,330 oz. These figures are only approximate, as many small operators keep no separate accounts and even the larger companies do not always segregate the quantity of gold obtained by the different methods of treatment that are adopted.

Manufacture and Uses of Tungsten

By W. E. John

*In its pure state tungsten has been comparatively unknown; it has been mentioned in connection with high-speed tools and the filaments of electric incandescent lamps; but today the metal is used for the production of electric contacts for the make-and-break of magnetos, and more generally for the contacts in connection with induction coils used in the ignition systems of a number of motor cars.

The metal is usually obtained from wolframite, FeMnWO_4 . There are, however, other ores, such as hübnerite, scheelite, and ferberite, that can be used. The ore is crushed, then reduced to a fine powder, then thoroughly mixed with Na_2CO_3 , care being taken that the soda is in excess of the WO_3 content of the ore. This mixture is roasted in a gas reverberatory furnace at a temperature of about 800°C . The result is the formation of sodium tungstate, Na_2WO_4 , a pasty mass which flows in a thick layer over the floor of the furnace. The floor is usually a cast-iron plate about 1 in. thick. The mass is raked out while hot, allowed to cool, and finely crushed.

It is then shoveled into wooden vats and agitated with hot water; the sodium tungstate goes into solution readily; it is filtered, and the saturated solution is passed into a precipitating tank. The clear liquid is heated by a jet of live steam to boiling temperature and is then treated with a solution of calcium chloride, CaCl_2 . A white precipitate, calcium tungstate (CaWO_4), is deposited. This is well washed and boiled with hydrochloric acid, giving a precipitate of tungstic acid, H_2WO_4 . This yellow precipitate is filtered and washed; usually it is found to contain 99.53% H_2WO_4 . This purity, however, is not sufficiently high for use in forming pure tungsten metal. The precipitate is therefore boiled with a solution of ammonium hydroxide and the result is, after filtration, a clear solution of ammonium-paratungstate. The solution is evaporated until a white mud of para-tungstate is precipitated, which is treated with pure nitric acid, giving a yellow precipitate of H_2WO_4 . It is again dissolved in ammonia and again treated with nitric acid, the repetition of dissolving and re-precipitation being necessary to get a sufficiently pure product.

This final acid product is fired in silica crucibles at a temperature of about 1000°C ., the water is driven off and the remaining powder, WO_3 , is bright yellow in color and is generally about 99.96% pure. The impurities may be iron, aluminum, and calcium in the form of oxides. As a matter of fact the metal that is produced from this tungstic oxide is of still greater purity owing to the volatilization of most of the impurities during the subse-

quent treatment. About 90% of the tungsten content of the ore is recovered.

The WO_3 is now reduced. It is heated to about 1200°C . in a closed furnace through which a continuous flow of pure hydrogen is passed. This reduction process leaves pure tungsten in the form of a dark-gray, fine, crystalline powder. The powder is stable under normal conditions. It will oxidize if heated in air and can be made to combine violently with sodium nitrate. If it is not completely reduced it has a bluish tinge, in fact at one stage of reduction it has a pleasing deep-blue color; this, however, must be avoided as the presence of oxide is fatal in the subsequent treatment.

The dark-gray powder is removed from the furnace after about seven hours of treatment, and is pressed in special dies under hydraulic pressure, which may be as much as 300 tons per square inch. The metal crystals adhere together to form a solid bar. These tungsten bars, usually rectangular in cross-section, will vary in size according to the size of the die used. A bar about $\frac{5}{8}$ in. square and $8\frac{1}{2}$ in. long weighs about one kilogramme with a density of about 15 to 17.

The pressed bar is now sintered in an electric furnace supplied with an atmosphere of hydrogen. The sintering heat is produced from the resistance of the bar itself. The temperature is about 3000°C ., which is built up in the bar in a few minutes. The heavy current necessary is usually provided from a special power-line through suitable transformers. The atmosphere of hydrogen prevents oxidation of the bar. The tungsten at this stage is in the form of a crystalline metal, heavy, that is with a specific gravity of about 17 or 18, and of a white silvery appearance. It is hard and generally with a smooth surface, but very brittle; in fact, it cannot be dropped from the hand on to the floor without danger of breakage. Should water vapor be present in the sintering furnace the bar may come out with a frosted appearance.

For making rod the bar is heated to about 1250°C ., usually in an electrical resistance furnace, and is passed into a swaging machine and reduced in diameter by a series of dies until it is down to as small as 0.05 in. Usually, however, it is left at about 0.175 in. to 0.125 in. in diameter. It is now of great density, having a specific gravity of about 19.3. Should sheet or ribbon be required, the bar may be pressed and sintered in suitable rectangular shapes, or the rod, at any diameter, may be subjected to a hammering or rolling operation to flatten it.

The product now obtained is a pure metal rod, ductile and fibrous. It is said that with care it can be welded at a bright yellow heat, but, from my experience, I doubt whether a true weld is made.

*Abstracted from the 'South African Journal of Industries'.

Tungsten is difficult to work because it is dense and tough. In fact a scleroscope test would probably show only 40, compared with 100 for hard steel; but the hardest file will not stand up to it, nor will a drill pierce it. It will, however, readily fracture under percussion or shock. It will melt at about 3075° C. The tensile strength is usually over 500,000 lb. per square inch. As with many other metals, the tensile strength of small wires increases above the proportionate strength of the metal in the coarser sizes. At the same time it becomes more ductile the more it is worked. It is not affected by air or water under a temperature of red heat. It is practically unaffected by sulphuric acid, hydrochloric acid, nitric acid, or hydrofluoric acid. Concentrated mixtures of HCl and HF will attack it, as also will fused nitrates, peroxides, bisulphates, alkali carbonates, and caustic alkalis; solutions of these chemicals do not affect it.

In the Pointolite lamp the principal light-giving body is a single crystal of tungsten, generally shaped as a sphere about $\frac{1}{2}$ in. diameter. The feature of the lamp is, as the name implies, the emission of light from one point. Tungsten, owing to its high melting point, is the only metal that can be used in this connection. The light from this lamp can be focused better than the light from any other incandescence lamp. The lamp operates on direct current, and the tungsten ball is heated by the electric current, forming an arc in a vacuum or in a suitable non-oxidizing atmosphere between the ball, connected to one pole, and a coil of tungsten wire, connected to the other pole of the circuit. The coil above mentioned is first heated on a separate circuit to heat up the parts so that the arc will be supported between the sphere and the coil.

Tungsten is also used for loading golf balls. The core of the ball is made of tungsten metal powder. With this heavy material as a centre, a finished ball of the same weight and size as the usual standard ball may have room in its construction for a larger proportion of resilient material, thus giving a livelier ball without altering the finished size and weight.

THE electrolytic recovery of zinc is advocated as an economic proposition in Great Britain, by S. Field, in a paper recently read before the Faraday Society of London. The British spelter industry is at present depressed and there is room for an enormous increase in the output of zinc. Home ores should, if possible, be used; abundant supplies of low-grade and complex ores are available; they are not amenable to distillation but respond readily to alternative electrolytic treatment. Processes have been worked out to effect economic recovery; sulphide ores are calcined to oxide and a predetermined proportion of sulphate; the calcine leached with acid zinc sulphate liquors (3% Zn + 10.5% H₂SO₄) from the electrolytic cells. Special treatment avoids gel formation, and admits of high extraction and easy filtration. The lead-silver residues are sintered, and go to the blast-furnace for the recovery of argentiferous lead.

The zinc-sulphate solution is too impure for efficient deposition. High purification is an essential for subsequent deposition. The methods worked out are given in detail and comprise the use of oxidizing agents such as air, ozone, lead, and manganese di-oxides for the removal of Fe, As, Sb, and Co. Zinc-dust in a slightly acidified solution readily removes Cu, Cd, and Ni, greater speed of elimination being obtained with the elimination of Co by the prior addition of about 0.005 to 0.01% Hg as sulphate. Ni and Co constitute two insidious impurities. The purified liquors contain not more than 3 to 5 parts of Co and 0.2 part of Ni per 1,000,000. The pure neutral solution is acidified down to 8% Zn + 3% H₂SO₄ and electrolyzed between lead anodes (which in the absence of certain impurities are permanent) and aluminum cathodes. The liquors attain a temperature of 40-45°C. and the cells, arranged in cascade, absorb 3.35 volts and give a current efficiency of 90%. This represents about 3200 kilowatt-hours per ton of zinc cathodes. The out-flowing liquor is used cyclically for extraction and acidification. Subsidiary power is amply covered by 800 kw-hr. per ton. Hence 400 kw-hr. (160 kw. per ton cathode zinc per day) covers all power. The cathodes are melted and yield ingots assaying not more than 0.02% Pb, 0.02% Cd, and 0.01% Cu and Fe together, with at least 99.95% zinc. Purification is simplified if only a 99.92% product is required.

THE discovery of a new mineral in Madagascar, containing a comparatively high percentage of radium, is reported in the 'Berliner Tageblatt'. The account adds that "the world supply of pure radium is not exactly known, for it is distributed in tiny parts of grammes, milligrammes, and fractions of milligrammes, over countless clinics, scientific laboratories, and industrial works. Statistics which have some claim to accuracy speak, however, of 100 gm. The larger part—namely, 60 gm.—is in the United States, the chief productive soil for radium. The Memorial Hospital in New York possesses the tremendous amount of 4 gm. In Europe there are two centres of the highest radium standard—Vienna, which preserves 2 gm. at the Academy of Sciences, and Paris, which, since Christmas, has concealed the like amount in the cellar of the Radium Institute, conducted by Madame Curie. In order to curb the fiery forces of 2 gm., it is let into a great hollowed stone, which is, moreover, clothed in a mantle of lead 30 centimetres thick. This repository of radium is said to resemble an image of Buddha. It is kept in a walled-in safe, which is closed by a heavy iron door. One gramme of the stock in the United States was presented recently to Madame Curie.

THE Australian total of 943,692 oz. of gold for 1920 is the smallest since the discoveries of the 'fifties, states a consular report. The largest on record was in 1903, when the total for Australia alone was 3,836,095 oz., and for Australia and New Zealand together, 4,315,841 oz., of a value of £18,340,563. Practically the whole of the 1920 output has been exported.

The Kantishna Mining District, Alaska

By James A. Haney

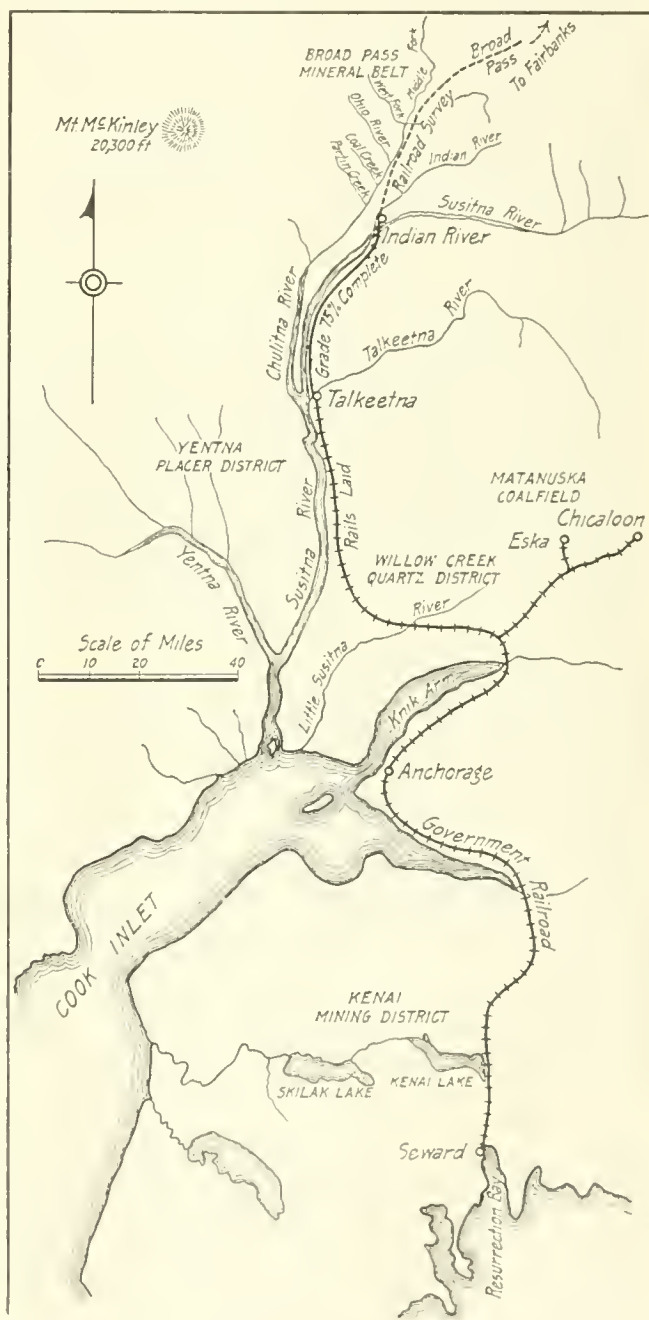
INTRODUCTION. The Kantishna mining district is situated north of Mt. McKinley and comprises some 650 square miles of the Yukon watershed, extending from the head of the Kuskokwim river eastward to within a few miles of the Government railroad. This railroad, when completed, will connect Seward on the coast of Alaska with the navigable waters of the interior, furnishing an all-year means of transportation for this district as well as for other districts farther inland. All of the mining activities of this district, both lode and placer, are confined to a range of mountains called the Kantishna hills, and prominent lode-locations have been made in an area some two miles wide and about 28 miles long. These so-called hills are rugged mountains of considerable size and are known as 'hills' only because of their nearness to the towering peaks of the Alaskan main range. At the mouth of Eureka creek, which is almost due north of Mt. McKinley, Lat. $63^{\circ}30'$ north, Long. 151° west, is the office of the U. S. Commissioner and Recorder; also the Kantishna post-office, which at present is the centre of mining activities in this district. Kantishna and Glacier City, a small cluster of cabins some 20 miles to the north, constitute the only settlements within the district.

ROUTES OF TRAVEL. This district is reached in summer by steamer up the Kantishna river 140 miles to Roosevelt landing, then 30 miles overland to Kantishna, or from Roosevelt landing 35 miles to Glacier. In summer and in winter the district is accessible by boat to Seward, then by rail to the end of construction, then by pack-horse in summer, or sleighs in winter, some 70 miles to the diggings. River navigation opens about the first of June and closes the first of October. A wagon-road is under construction from Roosevelt landing, and a survey is being made for a wagon-road to the nearest point on the railroad.

Freight on ore from this district to Tacoma or San Francisco averages about \$65 per ton. This includes a land haul of 30 miles and insurance charges. All labor is paid \$5 per day with accommodation; the mess cost is about \$3 per day per man.

POWER AND FUEL. A good grade of lignite can be obtained by a haul of from 10 to 20 miles. No permits have been taken out to develop this coal and no work has been done. As there is considerable overburden, little can be seen, except a few outcrops in the creek-beds, one seam about 10 ft. thick is exposed in the bed of Mosse creek, and lies flat. The quality of this lignite and the physical conditions offer encouragement to development, and a generating plant at the mine should be a source of reliable and cheap power. There are several hydro-electric power possibilities that could be de-

veloped to supply power for six months in the year and two or three that possibly could become available for a longer period. Representatives of two different companies have applied for permits to develop some of these



ROUTE TO KANTISHNA DISTRICT, ALASKA

water-powers. Scrub-timber can be had for fuel from the southern slopes of the mountains, but for mining-timber it would be necessary to go to the lower river-bottoms, a distance of from 10 to 15 miles.

TOPOGRAPHY. The mining area is characterized by sharp rugged mountains cut by narrow V-shaped valleys that radiate in all directions from the higher peaks, and with few benches or other evidences of heavy erosion. The elevation above sea-level is from 1200 ft. in the valleys to 5000 ft. at the summits. In summer this district is well watered by the many small streams that flow from the high mountains. The surface is covered with a white Caribou moss to the tops of the mountains and the lower levels are covered with a tundra and coarse bunch-grass that forms what are called 'nigger-heads'.

GEOLOGY. The Kantishna hills are made up chiefly of a highly metamorphosed schist, with an occasional igneous intrusion. The schist is mentioned by Capps, of the U. S. Geological Survey, as the Birch Creek schists, which are said to be "the oldest rocks seen in the region."* All the larger veins so far located cut the schist and have a general strike of N. 60° E. and dip at an angle of from 50° to 90° SE., and the preliminary work indicates that these veins are persistent in strike and dip.

LOCES. The first lode locations in this district were made by the placer miners, the discovery being made on the highest parts of the Kantishna hills where the absence of any overburden made prospecting the easiest. No real development work was done on these locations until the Great War brought on the high price of silver, which greatly encouraged development work. The general search for silver brought into the district many old-time quartz prospectors and they quickly traced many of the lodes to the creek-levels and made many other discoveries of importance.

The more important minerals that have, so far, been recognized are gold, silver, galena, gray copper, stromeyerite (copper-silver sulphide), chalcopyrite, stibnite, sphalerite, arsenopyrite, and pyrite; all these minerals are considered primary ore, but in places at the outcrop there is a shallow oxidized zone in which secondary minerals exist, such as lead carbonates and iron oxides. Any of these primary ores may be found in almost pure bunches, or they may be intimately intermingled. The stromeyerite, gray copper, and galena carry the most silver, and constitute the shipping ore. Last year one property shipped 500 tons of ore that assayed 180 oz. silver, 18% lead, and $\frac{1}{4}$ oz. gold per ton. The low percentage of lead was due to the fact that most of this ore came from near the surface and was much oxidized. This same property this year will ship about the same tonnage, but assaying 70% lead, 130 oz. silver, and $\frac{1}{4}$ oz. gold per ton. One other property will ship ore this year, and from the prospects and the development work being done there should be four properties shipping ore in the summer of 1922.

PLACERS. The first placer mining in this district was done in 1906 and all the alluvial mining to date has been open-cut work. The usual method is to ground-sluice the 'muck' and top gravel to within a foot or so of bed-

rock, the remaining gravel and some of the bedrock being shoveled into the sluice-boxes by hand. In this way only the shallow creek-valleys could be worked and up to the present time no attempt has been made to work the deeper bench-gravels that are known to carry gold. However, this year the hydraulic plants are being installed in the district, one on Moose creek at the mouth of Eureka and one on Caribou creek about 10 miles to the north. Some native silver is found by the placer miners and in at least one place heavy galena ore (float) is so plentiful as to clog the sluice-boxes.

PRODUCTION. The total production of placer gold to date is about \$400,000, and the total production from the lode mines is roughly \$200,000. There has been no record kept of the placer output and the estimated gross production is arrived at by a comparison of the estimates furnished by men who are intimately acquainted with the work done on the different creeks where gold is recovered by this method.

FUTURE. The future of placer mining in this district depends on the successful working of the lower-grade gravels by hydraulic or other methods, and the importance of the Kantishna as a lode-mining district depends on favorable results of development with depth. The low-grade sulphide ores may require some experimentation before a milling process is selected, but the Kantishna district offers no great difficulty to successful mining, provided a considerable tonnage is developed. The bonanzas are always the first to be exploited in any new camp and are a powerful magnet attracting men and establishing transportation. The new Government railroad ought to stimulate the mining activities of this district.

In the prefatory note to the reports on gold, silver, copper, lead, and zinc, issued by the U. S. Geological Survey, Edson S. Bastin draws attention to the fact that, in the mining industry, these five metals are closely related in both the genesis and the geologic occurrence of their ores. They also hold together in mining and in metallurgical treatment. Of their ores some contain all five metals, many contain three or four, and few contain only one. Gold and silver, for instance, on the one hand, and lead and zinc on the other, almost always stand in close genetic relations, and the ores of each two are usually mined together. Copper ores almost invariably produce some silver and gold as well as copper, and lead ores, with certain exceptions, produce notable supplies of silver. Zinc ores in the Western States contribute also to the production of silver. In the same mine sometimes, and in the same mining district frequently, all five metals occur in commercial quantity. This situation is recognized by the U. S. Geological Survey in its publication of the annual reports on the mineral resources of the country. Hence the general treatment of each of the five metals in the general reports and the grouping together of the related metals in the various mines reports descriptive of individual or geographically grouped States.

*Capps, S. R., 'The Kantishna Region', U. S. G. S., Bull. No. 687.

The Silver Horn District, Near Pioche, Nevada

By T. H. M. Crampton

The Nevada Silver Horn mine is situated in the camp of Silverhorn, Lincoln county, Nevada, about 23 miles north of Pioche, and 100 miles south of Ely. It is about 45 miles north-east of the old camp Delamar, and four miles from Bristol Wells, which was a town of 3000 inhabitants in 1876. A copper smelter was in operation for some years at Bristol Wells, as well as a mill for treating the silver and copper ores from the surrounding district. All that is now left is the slag dump and three bee-hive charcoal ovens.

The first discovery in what is now known as Silverhorn was made by John L. Whipple, a cow-man living at Sunnyside. While hunting for a stray horse, he was attracted by the massive outcrop, which projects from 10 to 30 ft. in places. He took a sample, which was assayed in Ely and gave returns of 103 oz. silver per ton. Mr. Whipple lost no time in returning to the ground and locating it. This time he took more samples; one he crushed, sending part of the pulp to two different assayers. The returns checked and showed 438 oz. of silver per ton.

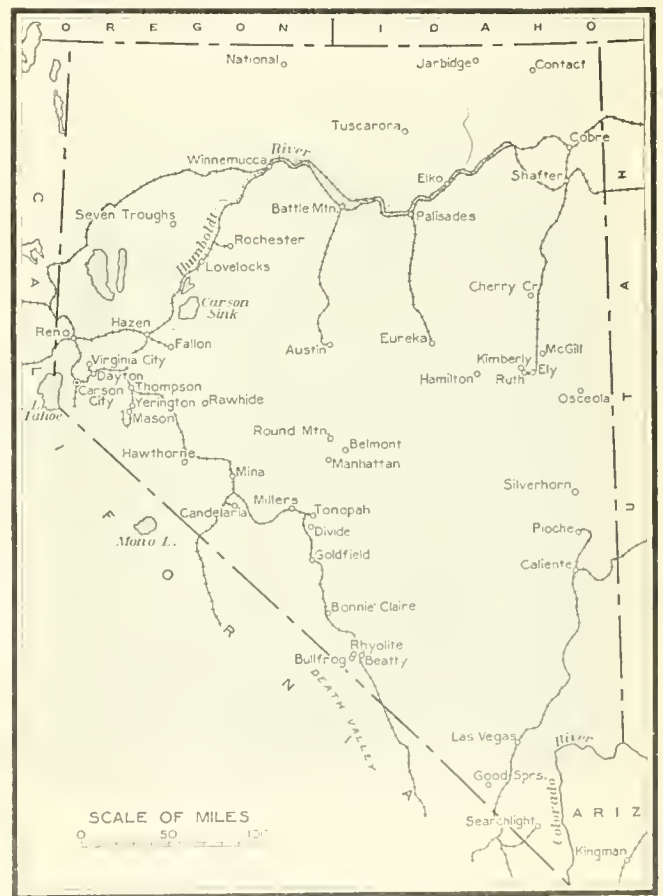
As he was getting ready to open the property Mr. Whipple secured a satisfactory offer and sold his interest to George Waddell, of Newcastle, England. The mine was operated but a short time when Waddell died. Apparently none of his heirs realized its value, or they were not in a position to look after the property, and Mr. Whipple bought it again at an attractive price. He subsequently disposed of the property to Crampton & Crampton, engineers of Santa Monica, California, and they in turn interested J. C. Weir, of Weir Bros. & Co., of New York, who sent Thomas H. France to examine the mine. Upon his recommendation the first systematic development of the property was begun in February of this year.

The outcrop was cross-cut and trenched at intervals of 50 ft. and sampled in width of from 10 to 90 ft. As the work of sampling the deposits progresses it is found that they are even more extensive than had been anticipated. To date approximately \$20,000 has been spent in this work and about 1000 samples have been put through the assay-office. Development so far has proved the existence of a replacement orebody which varies in width from 10 to more than 200 ft., and which has been exposed for a length of over 2000 ft. The strike is nearly east and west, and the vein dips to the north at about 23°.

The quartz occupies a position between a brown lime-shale hanging wall and a dark-blue limestone foot-wall, which is hard and compact. There is evidence of extensive movement along the contact of these formations, which resulted in a brecciation of both. The breccia was replaced by solutions carrying silica and silver. Gener-

ally throughout the extent of the outcrop the replacement has been complete; an average analysis of the ore shows 92% silica, with little iron or other impurities. There are occasionally found large masses of the original breccia which was never replaced, and which appears as 'undigested' masses irregularly scattered along its longitudinal extent.

Prof. Charles P. Berkey, of Columbia, a well-known petrographer, recognized in the many samples submitted



NEVADA

that "deformation continued after some of the silicification had been accomplished and shattered a part of the rock that had been already silicified. The mineralizing solutions that penetrated these later fracture lines of weakness healed them with vein quartz from the same source that had silicified the limestone, and toward the end of the operation furnished ore minerals, among which is a variety of silver-bearing minerals. There are no less than five or six of these ore minerals, all very intimately associated and ranging from sulphide in one extreme to the chloride of horn-silver on the other. Whatever is done with the ore must take this association

into account". This feature makes the new district of particular interest to engineers.

Across the outcrop at right angles to the longitudinal extent or strike are to be noted frequent shear-zones. These are the result of movement subsequent to the first mineralization and quartz replacement; they are the points that received the second introduction of primary minerals. These shear-zones are the richest areas along the outcrop. At one place the shear-zone is about 55 ft. across, while others range from six feet in width to 30 feet.

The fact that two-thirds of the outcrop is sheared makes the development of these zones of great interest. J. Nelson Nevius, of Pasadena, has been retained by the



THE NEVADA SILVER HORN OUTCROP

Nevada Silver Horn company as geological engineer, and under his direction a number of new disclosures have been made. These discoveries have been based upon the defining and locating of the shear-zones. It is of interest to know that the first introduction of mineral, which took place during the silicification of the breccia, carried silver into practically the entire mass to the extent of about five ounces per ton. The ore in the shear-zones will probably average between 15 and 30 oz. silver per ton. It is believed that at least one-quarter of the entire body will make profitable milling ore.

High-grade silver ore is frequently found and samples running as high as 3685 oz. have been secured, but the possibilities of the Silver Horn are based upon the large tonnage of milling ore now being blocked-out.

Thomas H. France is consulting engineer for the company. It is under his direction, and with his co-operation, that Frank A. Crampton, manager for the company, is blocking out ore. Upon completion of this development work the company may erect a mill, the capacity of which will be governed by the available ore disclosed. There have been many estimates of the developed ore, but the company has made no formal statement regarding this. However, it is believed that several hundred thousand tons which will average 17 oz. silver is reasonably assured.

The Silverhorn district is by no means a one-mine camp. The Silver Dale mine, which adjoins the Silver Horn on the west and is controlled by C. Walter Geddes, has the extension of the main vein-system and the showing of ore is favorable. A number of outcrops, similar in character to those found upon the large properties, are being prospected. The district has been visited by no less than 25 engineers, and the general opinion is that the disclosures of silver ore are larger than any heretofore discovered in the State of Nevada.

Silverhorn is ideally situated at an elevation of about 6200 ft., with water piped to the camp from a spring that furnishes about 30,000 gallons per day. There are many trees over the hills, so that wood for domestic use, and for small mine-timbers, is abundant. The nearest railroad point is Jackrabbit, on the narrow-gauge line running from the Los Angeles & Salt Lake railroad to Pioche. There are now more than 60 frame buildings, tent-houses, and stores in the camp, and the population in three months has grown to over three hundred.

FIFTEEN years ago Malaya produced more than 60% of the world's tin; today the figure stands at less than 40%, according to the 'Far Eastern Review'. In 1903 Bolivia was credited with under 10,000 tons; today that country is the second largest tin-producing country of the world; official estimates give it 20 to 25% of the total output. Nigeria, whose output 10 years ago was practically negligible, is returned in official statistics as producing in 1917 nearly 10,000 tons. The Malayan production in 1919 is given as 36,867 tons, compared with 50,000 tons five years before. The loss on Negri Sembilan output is more than offset by the gain in Pahang, while the loss on Selangor is easily cared for by the gain in Perak. Although the percentage comparison of Malayan output with the world's total has fallen, owing to greater production elsewhere, the actual output has considerably increased. Production has been affected by years of war restrictions and hindrances; present figures do not indicate the real strength of Malayan ore production; there is good ground for urging that the industry should be taken more carefully into consideration. At present there is one large and well-known American mining company (Yukon Gold) in the Federated Malay States. This firm is importing large quantities of material and sending out capable men as prospectors. As a result, many of the local mining corporations are taking a keener interest in scientific mining.

REVIEW OF MINING

MEETING OF THE ARIZONA CHAPTER OF THE AMERICAN MINING CONGRESS

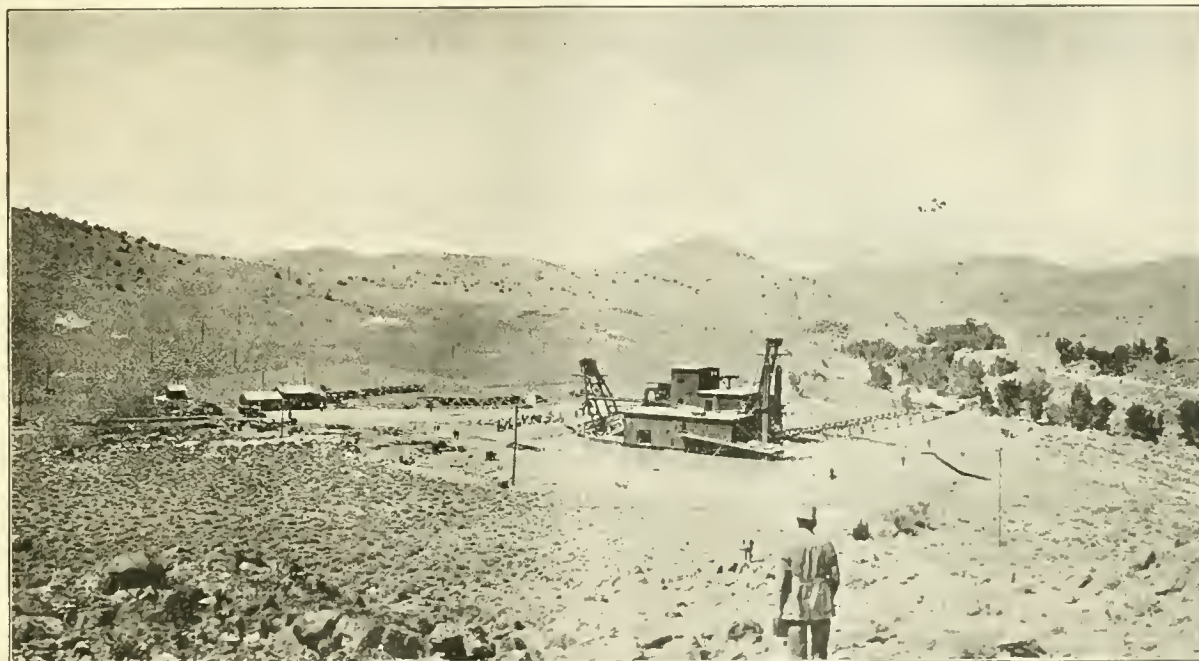
The Arizona chapter of the American Mining Congress met at Bisbee on June 13 and 14. The program for June 13 included the following: 'Present Conditions of the Copper Industry in Arizona and the Way Out', John C. Greenway; 'Steam-Shovel Operations on Sacramento Hill', Gerald Sherman; 'Powder', D. T. Fogg; 'Employees Representation', G. H. Dowell.

Mr. Greenway said: "There is a great field for the copper

and said that in his opinion, if a rate of \$6.50 could be secured from here to San Pedro a saving could be effected by shipping to Brooklyn by water.

SAN FRANCISCO SECTION OF THE AMERICAN INSTITUTE OF MINING ENGINEERS TO MEET AT VIRGINIA CITY

A field meeting of the San Francisco section of the A. I. M. & M. E. will be held at Virginia City, Nevada, June 27 and 28. Members going by train should leave San Francisco



The Gold Canyon Dredge Near Virginia City, Nevada

industry in Arizona by securing an outlet on the Gulf of California. This can be accomplished by the extension of 102 miles of track to a point that can be made suitable for the purpose by the construction of a breakwater and pier. This would be an extension of the little road from Gila Bend to Ajo, and from there to the gulf. The route is easy and the construction would be comparatively inexpensive."

He said that an estimate, based on existing rail-rates, indicated that if all the copper companies in Arizona shipped their product by the proposed route they would save a total of \$6,000,000 annually.

"The freight situation with regard to bullion", said Mr. Greenway, "is this: In 1907 the rate from Douglas to Brooklyn was \$8.55, and the present rate is \$20. The railroads expect to make a reduction to \$16.50, and say that they cannot reduce further. I accept the fact that they cannot reduce further, and believe this road would be a great thing for the copper producers of Arizona."

He spoke of the comparatively cheap shipping rates on the Pacific Coast, and by water from the coast to Brooklyn,

at 7 o'clock Sunday evening, train No. 6, arriving at Reno at 8:10 the following morning. Automobile transportation from Reno to Gold Hill will be provided for those members giving notice of their desire to so. Members will meet at the Jacket mine-office, at Gold Hill, at 10 a.m., June 27, and visit the mines and works of the United Comstock Mines Co. The afternoon will be devoted to a visit to the dredge of the Gold Canyon Dredging Co. The business meeting will be held Monday evening, when papers will be read by George J. Young on 'Mine Development at Gold Hill', and Gerald H. Hutten on 'Dredge Mining Practice'. On June 28, members will meet at 10 a.m. at the office of the Con. Virginia Mining Co. and pay a visit to the North End mines.

Mining is thriving in the Comstock region and the visit should be a profitable one. The United Comstock Mines Co., an enterprise directed by Bulkeley Wells and associates, embraces eleven old properties. It is probably the largest low-grade silver project in the world, and the preliminary arrangements before a pound of ore is run through the mill will cost \$2,500,000. The company has acquired control of

the Alpha Consolidated, the Consolidated Imperial, the Confidence, the Challenge Consolidated, the Yellow Jacket, the Crown Point, the Belcher, the Kentuck, the Seg Belcher, the Knickerbocker, and the Globe Consolidated. The central features of the project are a 10,000-ft. haulage tunnel linking up all the properties, and a mill on Gold Hill which will have a capacity of 1000 tons per day. At the Imperial the shaft has been sunk to the 400-ft. level, with drifting and cross-cutting until 2,200,000 tons of ore has been blocked-out.

The properties acquired by the corporation extend for 10,000 ft. along the Comstock Lode. Ore has been demonstrated for a width of 75 to 100 ft. and for more than 5000 ft. along the Lode. The two-mile haulage tunnel is being driven from seven faces and is now about one-third completed. The ore is to be worked by the branch-raise system, which has been perfected in large porphyry copper properties in Nevada and elsewhere.

The Gold Canyon Dredging Co., of which Wells is president, has completed the construction of a dredge that represents an investment of \$350,000.

The machine is constructed wholly of steel and weighs 900 tons. It is 108 ft. long and 52 ft. wide and has 2500-lb. buckets which can be loaded and dumped at the rate of

20 per minute. There is enough gold-bearing ground in the vicinity to keep the dredge running 24 hours per day for five years. Twenty men are required to operate it.

THE ZINC INDUSTRY

The whole Joplin district has been shut-down. The country today is getting almost all its domestic zinc from the Tri-State district embracing Kansas, Missouri, and Oklahoma. But even there, only 30 mills out of a total of 200 in the field are operating, or about 15% of capacity. This district, too, is able to operate only because of the rich quality of the ore. In April total output of zinc in this country amounted to 17,000 tons, or about 1500 tons below consumption, reducing surplus stocks in corresponding degree. Zinc stocks today are estimated at between 80,000 and 83,000 tons. But these stocks are not causing worry. The steel business is flat; galvanizers are therefore not buying any metal, and in normal times galvanizers take 66% of the zinc output of the country. The American Zinc, Lead & Smelting Co. operated at a slight profit in April, the first time in many months. Final figures for May are also expected to show a balance on the right side of the ledger. The company is operating at not more than 30% of capacity.

WORLD'S PRODUCTION OF LEAD, IN TONS [From the American Bureau of Metal Statistics]

Country	1911	1912	1913	1914	1915	1916	1917	1918	1919	1920
North America:										
United States	368,140	376,113	395,340	488,737	486,185	537,277	527,729	462,878	412,701	432,355
Canada	10,786	16,219	17,080	16,483	21,009	18,823	14,776	23,311	19,876	15,413
Mexico	124,600	108,000	62,000	23,598	31,384	19,960	16,612	88,503	78,615	84,200
Total North America	503,526	500,332	474,420	528,818	526,578	576,066	569,117	574,695	511,222	531,968
South America:										
Argentina	.....	.....	.....	1,088	1,546	1,611	2,743	3,436	3,905	3,500
Other South America	2,535	2,295	2,476	1,766	2,689	2,261	1,405	1,345	2,600	1,500
Total South America	2,535	2,295	2,476	2,854	4,235	3,872	4,148	4,781	6,505	5,000
Europe:										
Austria-Hungary	19,600	21,400	21,100	32,000	34,500	36,500	34,400	33,000	1,764	1,800
Belgium	14,300	51,200	53,590	70,980	16,770	15,500	22,745	20,630	4,225	8,000
France	23,600	31,100	28,817	29,601	14,539	24,276	21,235	12,778	10,928	12,000
Germany	164,300	174,700	188,000	180,250	121,700	106,807	86,228	70,000	51,500	54,400
Greece	11,300	14,500	18,309	20,684	11,595	9,426	1,422	4,093	3,841	4,000
Italy	16,700	21,500	21,674	20,461	21,812	24,362	16,237	18,332	16,530	15,915
Russia	1,000	1,000	1,523	1,000	1,000	1,000	.....	.....	.....	.....
Spain	189,919	232,612	198,829	143,524	171,472	147,406	172,909	169,709	125,721	142,000
Sweden	1,100	1,300	1,235	1,630	2,530	2,160	3,170	2,240	830	800
United Kingdom	26,000	29,200	30,500	19,584	15,797	12,890	11,430	11,083	10,441	10,000
Total Europe	500,819	580,512	566,577	519,817	411,685	380,387	369,776	341,865	225,780	248,915
Asia:										
Turkey	12,400	12,500	13,900	6,000	1,200	1,200	3,000	2,500	1,000	1,000
India (Burma)	.....	.....	5,931	10,218	7,059	11,266	17,137	19,380	18,827	24,197
Japan	4,125	3,733	3,777	4,562	4,764	11,370	15,806	10,684	5,771	5,000
Total Asia	16,525	16,233	23,608	20,780	13,023	23,836	35,913	32,564	25,598	30,197
Australia	99,600	107,100	110,100	91,950	95,090	111,232	162,568	177,810	84,682	11,713
Africa (Rhodesia)	.....	.....	.....	.....	185	1,261	3,882	9,308	12,859	13,900
Grand Totals	1,133,005	1,207,072	1,177,181	1,167,219	1,063,096	1,126,657	1,165,131	1,111,623	863,706	841,693

WORLD'S PRODUCTION OF ZINC, IN TONS [From the American Bureau of Metal Statistics]

Country	1911	1912	1913	1914	1915	1916	1917	1918	1919	1920
United States	267,472	314,512	320,283	335,935	460,076	616,908	619,679	176,594	127,909	435,153
Canada	.....	.....	.....	.....	.....	2,698	9,058	11,407	11,182	16,795
Belgium	135,092	200,198	204,220	145,925	51,660	22,930	19,290	9,245	19,860	84,046
France	57,105	64,269	67,890	42,473	19,180	20,258	22,929	18,347	10,800	19,655
Germany	247,900	269,200	278,800	236,000	185,357	178,015	186,500	171,000	85,000	97,465
Great Britain	66,956	57,231	66,243	50,800	52,426	52,629	51,918	39,001	38,227	25,000
Italy	.....	.....	.....	.....	.....	.....	258	367	1,188	1,172
Austria-Hungary	19,876	19,604	21,707	15,100	9,500	11,600	12,600	12,000	.....	.....
Yugo-Slavia and Czechoslovakia	.....	.....	.....	.....	.....	.....	.....	.....	4,010	6,000
Netherlands	22,732	23,932	24,323	16,513	11,130	12,101	4,059	681	.....	2,031
Norway	6,889	8,128	9,287	1,702	1,833	1,752	1,855	3,386	1,837	1,837
Poland	2,036	8,763	7,610	9,517	5,480	7,472	8,334	4,893	2,477	2,785
Spain	2,004	1,067	3,312	8,780	6,402	6,500	7,500	10,000	10,000	6,300
Sweden	1,000	1,500	2,000	2,300	8,600	10,000	8,000	4,100	2,320	1,450
Australia	1,767	2,106	4,187	4,572	4,674	4,826	3,607	5,537	3,404	3,920
Tasmania	.....	.....	.....	.....	.....	.....	51	3,556	4,877	5,900
Japan	.....	.....	900	5,881	21,137	38,993	54,718	39,008	19,816	10,885
Totals	896,381	961,937	1,010,762	875,528	837,597	987,021	1,000,726	810,212	641,550	719,394

WORLD'S PRODUCTION OF COPPER, IN TONS

[From the American Bureau of Metal Statistics]

Country	1911	1912	1913	1914	1915	1916	1917	1918	1919	1920
North America:										
United States	491,600	563,300	557,100	525,529	646,212	881,237	872,065	879,026	548,677	576,450
Mexico	61,900	73,700	52,800	36,337	30,969	55,128	47,503	75,529	60,491	50,480
Canada	25,300	35,300	31,900	34,027	47,202	47,985	50,626	52,693	36,106	35,500
Cuba	3,800	4,400	3,400	6,251	8,836	7,816	10,313	12,337	9,974	6,485
Total North America....	582,600	676,700	618,500	602,111	773,219	992,166	980,507	1,019,585	655,248	668,915
South America:										
Bolivia	2,600	3,700	3,700	3,874	5,868	5,150	6,400	6,000	7,000	9,900
Chile	36,420	41,647	42,263	44,665	52,341	71,288	102,527	96,565	63,930	94,531
Peru	27,735	26,969	27,776	27,090	34,727	43,078	45,176	41,114	39,470	31,276
Total South America....	66,755	72,316	73,739	75,629	92,936	119,516	154,103	146,979	110,100	135,707
Europe:										
Austria-Hungary	2,600	4,000	4,100	3,500	3,500	3,500	3,500	2,500	1,000	1,000
Germany	22,400	25,600	25,300	25,000	25,539	24,796	28,632	15,101	15,775	17,255
Norway	1,565	2,130	2,741	2,859	2,826	1,614	1,810	2,856	1,800	1,400
Russia	25,700	33,500	33,900	31,938	25,881	20,887	16,000	.....	.....	.....
Spain and Portugal	51,800	59,900	54,700	37,099	46,200	42,000	42,060	41,000	40,000	25,000
Sweden	3,221	3,957	4,215	4,692	4,561	3,181	4,423	2,956	3,558	3,500
Serbia	7,000	7,400	6,400	4,443	3,200	5,000	11,200	6,000	1,209	2,436
Total Europe	111,286	136,187	131,356	109,531	111,707	100,978	107,567	70,113	63,312	50,591
Asia:										
Japan	53,402	62,423	66,500	70,463	75,416	100,635	108,038	90,323	81,865	65,554
Total Asia	53,402	62,423	66,500	70,463	75,416	100,635	108,038	90,323	81,865	65,554
Australasia	15,979	46,343	45,617	38,667	37,709	39,855	36,564	44,722	16,111	26,186
Africa	17,309	16,600	22,900	27,033	31,300	39,815	42,656	31,064	31,350	32,230
Other Countries	6,300	5,300	3,800	5,000	5,000	5,000	5,000	5,000	5,000	5,000
Grand totals	886,622	1,016,169	992,442	928,167	1,087,247	1,397,967	1,131,133	1,108,086	963,646	981,483

at its smelters. Expenses throughout the whole organization have been drawn down to a minimum. Three wage-reductions of 50c. each have been made. At its new zinc-oxide plant in Columbus, the company is operating at about 50% capacity, or a production of between 3700 and 3800 tons of lead-free zinc oxide annually.

ONLY FIVE COPPER COMPANIES ARE PAYING DIVIDENDS

Only five copper-mining companies today are paying dividends. They are Utah Copper, which lately cut its quarterly dividend from \$1 to 50c. per share; Phelps Dodge, now paying \$1 quarterly; Miami, 50c.; Calumet & Arizona, 50c.; and United Verde Extension, 25c. per share. All these companies have closed their mines, except Miami. That producer is operating at close to capacity, making its metal for less than 12c. per pound and it carried no unsold metal over into 1921. Being low-cost producers, these mines were able to sell considerably more metal on the decline in the price of copper during the last six months than the others. They all finished 1920 with relatively large surpluses of net current assets and they have, therefore, been able to continue dividends longer than the rest.

CALIFORNIA

Downieville.—Thomas Brannigan, recently appointed superintendent of the Kirkpatrick mine, has a gravel-mill ready to commence operations. Ventilation in the mine has been improved by connecting with the old Magnolia tunnel.

Georgetown.—New machinery has been installed at the Grit mine. Three shifts of miners are employed under the direction of Walter King. New machinery has been purchased for the Argonaut mine, between Georgetown and Greenwood, which was recently purchased by Sacramento capitalists.

Grass Valley.—At the special meeting of the Mine Workers' Protective League held on June 19 and attended by more than 600 men, it was decided to submit a counter proposition to the mine operators, offering to accept one-half of the \$1 cut proposed, to go into effect on July 1. This would make the wages \$4.62½ for miners and \$4.25 for shovelers. It was decided to call a mass-meeting of all citizens for a public discussion of the question from all angles; the mine operators will be invited to attend.

Although the proposed new wage-scale of the leading mines here was rejected by the Mine Workers' Protective League, it is announced that it will be put into effect on July 1. At the North Star property it was stated that the management was preparing to close the mine in the event of the employees not caring to work for the wage offered, which is \$4.25 for machine-miners and \$3.75 for shovelers. The mines taking the lead in the matter are the North Star, Empire, and Idaho-Maryland, the latter being in process of re-opening. The smaller properties will follow the lead of the larger operators.

Redding.—Platinum and iridium are being mined on Beegum creek in the south-western part of Shasta county. Twenty-five men are doing well, making from \$10 to \$15 per day. The creek is staked for seven or eight miles. Pans and rockers are used in washing-out the metals. The great trouble now is that the water is too high, due to the snow melting in the mountains.

Sonora.—A mill is being completed at the National mine near Groveland. New equipment also includes two marine-type gas-engines, a hoist, and a compressor. Adits, shafts, and winzes aggregating 1000 ft. have been driven to develop the property. The mill is expected to start about July 15.

Tin Mountain.—George Allen, Arthur Smith, and B. B. Foreman have entered into a contract with the Tin Mountain Mining Co. to develop the nine silver-lead claims of that company and work has been started. These three men have a contract to work for one year, taking their wages in stock at a rate of 5000 shares monthly. All of the stock in the company is owned by William Foreman and J. B. Kendall of Goldfield, with the former holding a large controlling interest. The claims are 20 miles south of 'Death Valley' Scotty's ranch and are in Inyo county. A 23-ft. shaft has been sunk in the vein and a drift is being driven from this into the mountain, gaining depth rapidly. Five tons of \$154 ore was saved in sinking the shaft and several tons assaying \$165 has been saved in driving the drift, which is 20 ft. long. The width of the vein is not known; the ore-shoot is 20 in. wide at the face of the drift.

Weaverville. Lewis Gardella, the Oroville dredge operator, has contracted to purchase the Paulsen ranch at Lewiston on the Trinity river. The place contains 300 acres. It has been thoroughly prospected by drilling, so the gold con-

tent of the gravel is known. Gardella has commenced the construction of a dredge. The Star Dredging Co. had an option on the farm a few years ago and commenced to assemble material and machinery, but its enterprise was abandoned.

COLORADO

Aspen.—Operations are shortly to be resumed at the Annie mine as a result of the discovery in the Hope tunnel. The Annie is believed to be situated on the same vein, but higher up the mountain by 1600 ft. An examination of old workings disclosed considerable ore in sight and in filled stopes with the dump containing a large quantity of low-grade mill ore. A 50-ton mill on the property equipped with ball-mill, concentrating tables, and flotation unit will be put in shape to treat low-grade silver-lead ores.—The Hurricane company is planning to develop its properties in this section by cross-cut from Hope tunnel.

Breckenridge.—Under instructions from the main office at Kansas City, the Wellington Mines Co. shut-down its mines and mills on June 15. About 40 employees were affected. No reason was given, but the shut-down is understood to be due to the price paid for zinc. The company was the heaviest producer of zinc ore in the county. The ore mined carried from 25% to 48% zinc with some silver and lead. Dividends paid to date total \$1,950,000.

Cripple Creek.—Traffic has been resumed over the Midland Terminal and Midland roads and ore accumulated during the temporary suspension of service is being moved in trainloads to Colorado Springs for treatment at the Golden Cycle mill.

Leadville.—The tunnel of the Leadville Mines Development Co., to which enterprise citizens of Leadville have subscribed in excess of \$27,000 at \$1 per share, has been driven to date beyond the 350-ft. point in wash and is now believed to be entering the Weber grits and shale. A raise was carried through for ventilation at a point 289 ft. from the portal. The tunnel is projected to exploit the Canterbury hill territory, and is carried 5 by 7 ft. in the clear with a drainage-box on one side.

IDAHO

Coeur d'Alene.—After expending more than \$50,000 during the last two years, the Columbus Mining Co. has closed a contract with the Union Iron Works of Spokane for new machinery. The property consists of 15 claims in the Murray section close to the Jack Waite. The lower adit has been driven 550 ft. and another 500 ft. of cross-cut should tap the first vein on the Tributary creek side fully 800 ft. below the outcrop. E. P. Gallagher is manager.

B. N. Sharp, of Spokane, is driving an intermediate tunnel in the Nabob mine. The distance between the main Nabob level and the Denver level is 236 ft.; the tunnel is about half way between these two levels.—At the Sidney property 60 tons of first-class shipping ore is stored in the bins. This will be moved to the smelter as soon as a tramway can be installed.

Work on the new 50-ton concentrator at the Yankee Boy mine on Big Creek is progressing. Timbers are on the ground, grading has been completed, and most of the machinery received. Shipments are going forward at regular intervals and several sets of lessees are taking out the ore. The Sunshine company, operating the mine, is driving a long cross-cut adit to intercept the Yankee Girl vein.—Stockholders of the North Bunker Hill Mining Co. have elected the following directors: Elmer Brown, N. T. Hardy, A. W. Van Guilder, F. C. Cartwright, J. L. Trowbridge, and J. E. Gunn. Development work is proceeding from the 500-ft. level of the main shaft.

Hailey.—E. W. Ring has 100 men employed at the Independence and North Star Mines in the Wood River section.

A small vein recently discovered assayed 100 oz. silver and 60% lead. Work has been suspended on the North Star orebodies, awaiting further metallurgical tests in the treatment of the complex sulphides of zinc, lead, and silver along with gold ore.—Oscar Hershey, employed by the Bunker Hill & Sullivan company, is engaged on a comprehensive investigation of a number of old mines in the district. Among these are the once famous May Flower, Goned, Red Elephant, Idahoan, Eureka, Ited Cloud, Minnie Moore, and Queen of the Hills, all heavy shippers in their day.

Lewiston.—Robert N. Bell, former mine inspector of Idaho, who has made examinations of copper properties along the Idaho side of the Snake River canyon, 100 miles south of here, says that diamond-drill development has disclosed large quantities of primary copper-sulphide ore carrying precious metal. Assays of 3% copper and \$4 in gold and silver have been obtained.

Pearce City.—The Bloyer Mining Co. began operation of its new mill on June 1. The ore is free-milling, worth from \$13 to \$25 per ton. The new plant includes a 25-ton Chilean mill, a 75-ton Downey crusher, and a steam-power plant.

MICHIGAN

Houghton.—Copper is again moving rather freely out of the Lake Superior district in spite of the fact that just at present there are few inquiries for the metal. Most of the copper moved within the last two weeks represented business placed some time ago, although some 'spot' metal was included. Three large cargoes, totaling 5,000,000 lb., have been taken out. The first of these shipments, amounting to 1,800,000 lb., was made up of 500,000 lb. of Calumet & Hecla metal, the remainder being divided between the Copper Range and Quincy smelters. The Michigan smelter handles Copper Range, Mohawk, and Wolverine copper. With the exception of 156,000 lb. for export, the metal was consigned to domestic points, including 300,000 lb. of Calumet & Hecla copper for Detroit. Of the export metal, 112,000 lb. was Calumet & Hecla and 44,000 was Copper Range business. The second cargo, 1,600,000 lb., was Calumet & Hecla copper for export to Germany. The third shipment, 1,600,000 lb., was made up of 1,200,000 lb. of Copper Range copper and 400,000 lb. from the Quincy smelter. Of the Copper Range metal, 600,000 lb. was for export. In addition to the above, Calumet & Hecla has shipped two carloads of copper to Illinois consumers.

Calumet & Hecla still has a considerable amount of mineral and mass copper on hand at its smelters, which will be held in reserve in the event any more orders are received from abroad for special shapes or sizes. This will obviate the necessity of re-smelting copper already refined. Calumet & Hecla keeps six furnaces in commission. At present they are employed in smelting cupola blocks, making anodes for the electrolytic plant where the silver and impurities are removed. The copper is then returned to the smelters in the form of cathodes and refined.

In the Calumet & Hecla and subsidiary mines, advantage is being taken of the shut-down to make essential repairs. Some shaft work is under way and attention also is being given to surface plants and machinery. At Lake Linden some work has been done on the big dredge at the reclamation plant. Little timbering has been found necessary in any of the Calumet & Hecla or subsidiary shafts and underground conditions so far as timbering is concerned are good. When mining is resumed it will be necessary to do some timbering immediately, but this work will not take long and can be done without undue interference with production. In the meantime, Calumet & Hecla is shipping in timber, about 100 carloads having already been delivered.

The ground being encountered in the Kearsarge lode penetrated by the cross-cut from the S1st level of the Red Jacket

shaft of the Calumet & Hecla is described as neither "good nor bad", nevertheless the work will proceed until it is proved definitely one way or the other. The drifts, both ways, are now in a total of 400 ft. The good 'rock' is being taken out and put in a stockpile near the shaft for a mill-test later. Only a small force of men is employed on this work.

In the Mayflower property, the south cross-cut from the 1700-ft. level is still in vein matter. The east drift, however, is getting into trap. The 'rock' opened in the south is of encouraging character.

MONTANA

Butte.—The Davis-Daly company is blocking out ore on the 2300 and 2700-ft. levels of its Colorado mine. The company is in position to hoist 400 tons of 5% copper ore daily.—The East Butte company is operating its mill and flotation plant seven days per week instead of five days as was the program several weeks ago. Ore received from the Davis-Daly company assists the East Butte in maintaining operations.

Marysville.—At the bottom of an 80-ft. shaft in the Etna mine Lawler Brothers are reported to have uncovered a 2-ft. vein of gold ore that assays \$60 per ton. The Etna was formerly known as the Mexican mine.

NEVADA

Arrowhead.—Mark G. Bradshaw, consulting engineer, has started sampling the Arrowhead to determine whether the ore exposed justifies the building of a mill. It is estimated that 750 to 1000 samples will be taken. The shaft, now 330 ft. deep, may be sunk another 100 ft. as a result of the sampling.

Eureka.—It is reported that the Eureka-Uncle Sam Mining Co. has purchased the patented claims and bonded four unpatented claims which formerly all belonged to the Hamburg Mining Co. The Uncle Sam adit is in about 630 ft.; a late sample from the face assayed \$49.80. Work will soon be resumed in a drift from the adit, now in 200 ft.—Adams hill now looms up as the most active part of Eureka district. The Eureka Holly Extension Co. has begun operating, with S. C. Scott as superintendent. A new hoisting plant has been brought in from Elko and will be installed at the Standard shaft, which is 300 ft. deep. Surface prospecting at about 100 ft. south-west of that shaft has resulted in finding a fissure 18 in. wide, which carries ore that assays 56% lead, \$2.06 in gold, and 42 oz. silver per ton.—The Eureka Prairie Mining Co. has purchased and made the first payments on Marguerita, Fraser and Molino, Morning Star, Macon City, and Lone Star mines, on Adams hill, all of them producers of gold and silver and amenable to treatment by straight cyaniding. The company is cleaning out and laying track in the Marguerita adit. Trucks are in use hauling the timbers and building material purchased by the company at Buckhorn.—At the Eureka-Holly mine the 400 and 500-ft. levels are producing high-grade ore. A raise is being cut from the 600-ft. to the 500-ft. level, for better ventilation, as well as to prospect for the continuation of some high-grade ore that was mined on a limestone-porphry contact.—During the last two weeks the Richmond-Eureka company shipped 20 tons speiss, and the Eureka-Croesus and Eureka Nevada mining companies each shipped four cars of ore to the Utah smelters.

Klondyke.—There is 2000 tons of ore awaiting shipment in the Klondike district, according to testimony given at a hearing before the State Public Service Commission in an action brought by the Tonopah & Goldfield railroad to suspend service to and from Goldfield and Tonopah. It is reported in Tonopah that the Belmont company hopes to be able to accept custom ores soon. It is said the mill

is to be re-started in a short time, which will bring relief to the Klondyke shippers.—The bins and all available workings in the Knox are filled with ore. This company continues drifting east on the 65-ft. level and, after re-opening the shaft to 145 ft., a drift is being driven east at this depth toward the ore-shoot.—The McSherry sub-lease on the Original Klondyke recently shipped 12 sacks of high-grade ore and last week 52 sacks of \$237 ore was shipped from the Goldman sub-lease.—There is one ton of \$1000 ore sacked at the Maupin sub-lease, with several hundred tons of lower-grade ore on the dump. Charles Brandon of Goldfield has a contract for sinking the Ben Hur shaft to



The Old Atlas Mill Near Sneffels, Colorado

150 ft. and he has started work. Several lessees on the Ben Hur have opened ore.

Tonopah.—The force of state police that was at Reno prepared to go to Tonopah has been demobilized on receipt of notice from Nye county officials that they were not needed for strike duty. The situation in Tonopah has been quiet recently. The companies are reported to be having trouble training the men imported from the coast. The Tonopah Extension mill has been re-started.

OKLAHOMA

Picher.—The following mining companies suspended operations during the week of June 12; Lucky Jew, Monarch, Black Eagle, Manhattan, Niangua, and Royal. With zinc 'ore' quoted at approximately \$20 per ton, other mines are likely to suspend operations.

UTAH

Kureka.—The Tintic Standard Mining Co. has made a favorable settlement with the Federal Government as regards income taxes for the years 1916 to 1919, both inclusive. The amount claimed by the Government was \$360,000 over and above what the company had already paid, and this sum was reduced to \$84,031. This reduction comes as the result of several months' work on the part of the company's engineers, who convinced officials that the depletion reserve, as estimated December 31, 1917, and based on the actual net value of ores, amounted to \$4,150,000 instead of \$1,800,000, as first set down. Recently a new orebody has been uncovered on the 1100-ft. level. The company's milling plant is treating from 140 to 150 tons per day, with highly satisfactory results, according to E. J. Raddatz, president.

Conditions at the Little May property, in the south end of the district, are reported as encouraging, by John Matson, manager. Recently a streak of ore was opened up, which is from 18 to 20 in. wide, with average returns of \$1.40 in gold, 18.3 oz. in silver, and 6.5% copper. Owing to the high sulphur content of the ore, a favorable treatment charge has been secured from the Tintic Milling Company.

Shipments of ore from this district for the week ending June 11 totaled 137 cars, as compared with 119 for the previous week. The Tintic Standard shipped 56 cars; Chief Consolidated, 37; Iron Blossom, 8; Eagle & Blue Bell, 7; Iron King, 6; Colorado, 6; Swansea, 4; Victoria, 4; and Gemluf, 3.

Park City.—Shipments of ore from this district for the week ending June 11 totaled 1009 tons, of which the Judge allied companies shipped 405; Silver King Coalition, 382; and the Ontario, 221.

Salt Lake City.—The United States Smelting Co. has notified shippers of silver-lead ore that the reduction in freight-rates on bullion from Utah smelting points to the Atlantic seaboard, amounting to \$5.50 per ton, will be passed on to producers as soon as they become effective. This will mean a saving to the shippers of one cent per ounce of silver and 1c. per pound of lead and copper.

According to figures made public by the United States Geological Survey, this State produced 97,454 oz. of gold, 13,106,976 oz. of silver, 116,931,238 lb. of copper, 140,838,113 lb. of lead, and 8,157,739 lb. of zinc in 1920. With silver at an average price of \$1.09 per ounce, copper 18.4c. per pound, lead at 8c. per pound, and zinc at 8.1c., the value of the above output was \$49,744,334, as compared with a total of \$45,169,228 for 1919.

After a rather explosive hearing before the State Securities Commission on June 16, on the petition of the Bingham-Galena Mining Co. to sell 467,100 shares of treasury stock, the Commission took the application under advisement and a decision will be rendered shortly. The Bingham-Galena was incorporated for 1,000,000 shares. The property now consists of the old Silver Shield holdings, for which 300,000 shares were paid. Two additional tracts were purchased, one for 50,000 shares and the other for 70,000 shares. Silver Shield stockholders, under an option, subscribed for 13,000 shares additional at 15c. per share. When the Utah Power & Light Co. recently cut off power service at the mine in default of a bill of about \$700, an additional block of 7500 shares was sold. It is proposed to make a contract with George Graham Rice to underwrite the 467,100 shares, and to such a proposition a number of the stockholders objected, on the ground of the bad reputation of Mr. Rice as a promoter. James A. Hogle, the well-known financier of Salt Lake City, told the Commission that "he believed it would be most unfortunate for the Silver Shield and for Salt Lake City to have George Graham Rice come here at this time to undertake the financing of the Bingham Galena

project". The decision of the Commission is awaited with interest.

One of the most destructive, as well as spectacular fires in the history of Utah, occurred at North Salt Lake on June 11-12. About 5:50 p.m., on June 11, a bolt of lightning struck a huge steel tank, with a wooden roof, on the property of the Utah Oil Refining Co. In an instant the 1,500,000 gal. of distillate was a seething furnace, and dense clouds of smoke ascended to a height of five or six thousand feet. The city fire department, assisted by employees of the oil company, succeeded in keeping the flames confined to the large tank until 7:30 a.m., June 12, when it exploded, with deadly results. Three employees of the oil company were either killed outright or died as a result of their burns, while 45 others, mostly city firemen and oil company employees, were injured. Burning oil was scattered for a radius of a quarter of a mile, and it was deemed advisable to remove the 105 patients from St. Marks' hospital, about two blocks distant, to other hospitals in the city. Most of these patients were employees of the various metal and coal-mining companies of Utah. Immediately following the explosion, several smaller tanks were set afire, and it was not until nine or ten hours later that the flames were brought under control. J. C. Howard, president of the oil company, estimates the loss at \$350,000. The Utah Oil Refining Co. plays an important part in the mining industry in Utah, as practically all of the metal mines using flotation secure their oil from the plant, in addition to their lubricants.

Santaquin.—At present the Syndicate mine is working two shifts, driving the adit into a promising vein in the south-east fissure. The tunnel is now in 2145 ft. and is at a depth of 800 ft. below the surface. Benjamin H. Bullock is manager.

Tooele County.—Development at the Pennuva Copper mine is encouraging, according to J. B. Christensen, who is in charge. This property is situated in the Silver Zone district. In the south shaft, 16 in. of ore, averaging 75 oz. silver, has been discovered.

WASHINGTON

Deer Trail.—A contract has been let to haul ore from the old Queen and Seal mine; 125 tons of high-grade silver ore is sacked for shipment. In the early days the mine is said to have produced a profit of over \$300,000 in one season.

Kettle Falls.—At the Silver Queen group a cross-cut tunnel has been driven 1070 ft., intersecting the Silver Queen vein at a vertical depth of 400 ft. The vein contains silver.

BRITISH COLUMBIA

Prince Rupert.—By unanimous judgment the Court of Appeals has dismissed the appeal brought by the Premier Gold Mining Co. against the decision of Judge Young, of the Prince Rupert County Court, in which a miner named Caskie was awarded \$77, being wages at \$5.50 per day from the time that he arrived at the mine until the earliest date that he could return to Prince Rupert. There are 22 other claims of a similar nature against the company. During the strike last year the manager came to Prince Rupert to engage labor, and, as men refused to go to the mine to engage as strike-breakers, he assured them that the strike would be settled when they got over to the mine. The strike, however, was not settled, and the men refused to go to work. The strike was settled 52 days later, when Caskie went to work for the company. He brought suit against the company for the 52 days during which he was idle, but was awarded wages for only two weeks, it being impossible for him to return to Prince Rupert during that period.

The Drum Lummon Mines, Ltd., has been reorganized and has changed its name to the Douglas Channel Mines,

Ltd. The new company has a capital of \$3,000,000, and the shareholders in the old company will receive share for share in the new company, with the understanding that the shares are to be pooled for two years. The Glenville A. Collins Engineers, Ltd., are to receive 600,000 shares, in consideration for which they are to liquidate all the debts of the old company, to build a wharf, sink a winze 100 ft., and drive 200 ft. on the vein; all of which must be completed within 15 months. Fred G. Jarret has been appointed superintendent of the mine, and work at the mine will be re-started at once.

The Belmont-Surf Inlet Mines, Ltd., expects to have its new mine, the Pugsley, ready to start production within the next two months. The company has been developing this mine for some time and has demonstrated the existence of a large body of high-grade ore, said to average \$75 per ton. At the Surf Inlet mine some 250 men are employed, and the mine is turning out 450 tons, running about \$10 per ton, daily. An aerial tramway is to be built from the mine to the mill, a distance of about three-quarters of a mile.

Sheep Creek.—Harold Lakes, superintendent for the Nug-

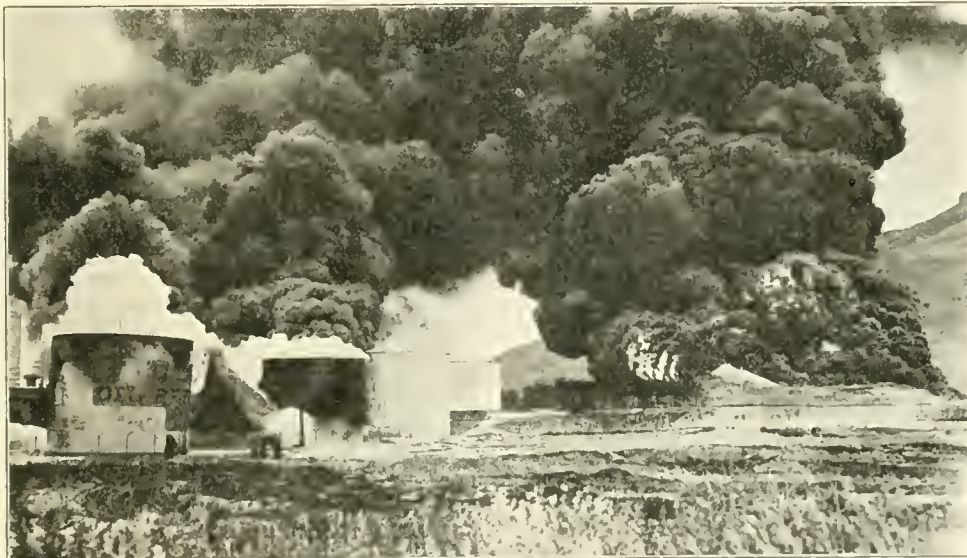
10,000 piculs at 38.50 yen is reported as having been made for export to South China and of 5000 piculs at 39 yen to the Chinese government mint. The reduction in prices announced by foreign steel companies resulted in similar reductions by the Japanese government steel works. The price of cast-iron is announced as 170 yen per ton, a drop of 50 yen. In general the reduction announced April 18 amounts to approximately 20% on all stocks.

MANITOBA

The Pas.—A rich gold strike is reported at Elbow Lake, in the Athapapuskow mineral area. The vein is stated to be 50 ft. wide carrying free gold and has been stripped of its overburden for 350 ft. The find was made by the Murray brothers about three weeks ago and has caused great excitement.

MEXICO

Concepcion del Oro (Zacatecas).—Rodolfo Frias has applied for titles to four pertenencias bearing gold and silver, situated in this mining district.—The Mazapil Copper Co. is still operating its mines and smelter at Concepcion del



The Recent Fire at the Plant of the Utah Oil Refinery Co. at Salt Lake City

get Gold Mines, Ltd., complains that, notwithstanding the amount of unemployment said to exist in the Province, he is unable to get skilled miners. At the present time only 35 men are employed underground, and with that number he is entirely unable to maintain a supply of ore to keep the mill going. During May the mill crushed 2100 tons of ore, and made a considerable inroad on the supply of ore that had been broken in the stopes before the mill was started.

Vancouver.—The value of the Panama Canal to Canada, as well as to the United States, is being demonstrated in these days of high freight-rates. The 'Robert Dollar', which brought 700,000 lb. of steel cable for the Premier mine tramway, will carry back to New Jersey 2200 tons of blister-copper for refinement. This is said to be the largest single consignment that has ever gone East from the Anyox smelter.

JAPAN

Tokio.—The copper market is showing a remarkable improvement, both in reduction of stocks previously held and in price. The copper guild has for some time maintained the conventional price of 40 yen per picul (133½ lb.), but since February 1, actual sales have been ruling at from 35 to 37.50 yen. During the last week of the month orders have been placed at 39.70 yen for small lots. A sale of

Oro. There has been an improvement in freight-traffic, relieving the fuel-shortage.

Saltillo (Coahuila).—Francisco F. Salas, a mining man of this city, has located four claims in the Agujerada mountains valuable for their zinc ores. Development work is being carried on.

Sombrerete (Zacatecas).—Filings have been made at the mining agency in this city for titles to the following groups of mines: El Guardo, consisting of 12 pertenencias or mining claims, situated at La Noria; Santa Catarina, comprising 54 claims at San Miguel del Mezquital; Zuluaga, 4 claims at San Pedro de Ocampo; Purisima, 6 claims in La Noria district; La Gallega, at La Noria; La Soledad, comprising 11 claims near La Noria; and La Providencia group of 5 claims on the Hacienda de San Jose.

Torreón (Coahuila).—Construction work on the railroad from Rivas station to the Sierra de Ramirez mining region in the San Juan de Guadalupe district is being rushed to completion. The entire length of the line will be approximately ten miles, about seven of which is now completed. The branch will tap the rich mining district of the Ramirez mountains and will facilitate the transportation of ores from the numerous mines to the main line of the National Railways. It is one of the richest silver-lead districts of

the State of Durango. A number of new mines are being opened up in this vicinity which will be in condition to ship as soon as this new railroad is in operation. Contracts are being made with the Torreon smelter and the Agunscaientes plant. The latter has been operating only two copper furnaces, but will shortly blow-in one of its lead-furnaces.

ONTARIO

Cobalt. Silver production from the mines of Cobalt has increased to between 750,000 and 800,000 oz. monthly. The four leading mines are in full operation, namely: the Nipissing, Mining Corporation, Coniagas, and O'Brien. Three other smaller mines are producing, these being the La Rose, Bailey, and Chambers-Ferland.—Fire destroyed the transformer in the mill on the Keeley mine, and the mill will not be re-opened until the last week in June. Ore-reserves are now estimated to contain 600,000 oz. of silver.—The Balley custom mill treated 5019 tons of ore during May, 3960 tons being custom ore from the La Rose, Silver Leaf, and Ophir, and 1059 tons coming from the Balley mine itself. Gross earnings on the custom ore treated amounted to \$11,838.

The annual meeting of the Ontario Mining Association was held at Cobalt on June 16, 17, and 18. In addition to the general invitation to those who represent the 41 Ontario mining companies which belong to the Association, special invitations were sent out to 36 individuals who are identified with the mining industry, five of these being officials of the Ontario Department of Mines. A feature of the meeting was a cruise on Lake Temiskaming and a visit to the Wright mine, where silver-lead ore was found more than a century ago and which is said to be the oldest mine in Canada.

Porcupine.—At the Dome mill the work of overhauling the stamp equipment, which has not been used for some years, has been completed, bringing the capacity of the mill up to about 1100 tons daily.—The North Crown has been closed down, as explorations for the discovery of new ore were not successful. It is understood that re-financing will be necessary before work can be resumed.—The Hollinger Consolidated is raising ore from the 1250-ft. level by the central and old Hollinger main shafts, which are down 850 ft., the lower level being reached by a winze.

SOUTH AFRICA

Johannesburg.—At the annual meeting of the Crown Mines, Samuel Evans, chairman, stated that the working profits for the year were £1,930,336, due mainly to the 'premium' on gold. The cost per ton mined was 51% higher than in 1914. He said that the chief problems confronting the industry were the supply of unskilled labor and working costs. Regarding the prospect for the future, the chairman said that the annual production of gold in the world had diminished by 27% since 1915, while the probabilities were that in the course of the next few years the demand for gold would be greater than it had been since the adoption of the gold standard by England. During and since the War, the desire for gold among the people of the Far East had been enhanced, and the use of it for currency purposes both there and in South America had increased. It was almost certain that Russia would eventually come back to gold without any paper money in circulation as Mexico did five years ago and as France did after the Revolution. The time could not be far distant when the areas which constituted the Austrian Empire and other countries whose paper currencies had become almost valueless would also be obliged to abandon paper for gold. Undoubtedly the capacity of Russia and the neighboring States for absorbing gold was enormous, and it was quite conceivable that in a not distant future the peasants of those countries would be exporting the products of field and forest at prices in gold lower than anything ever heard of before.

PERSONAL

The Editor invites members of the profession to send particulars of their work and appointments. The information is interesting to our readers.

C. B. Lakenan sails from Seattle to Juneau on July 2.

J. E. Steele, of Hayden, Arizona, is at St. Louis, Missouri.

W. A. Argall, of Thane, Alaska, is at Denver, Colorado.

Horace W. Edmundson is now at Eden Four Corners, Vermont.

K. F. Klein has moved from New York City to Alma, Park county, Colorado.

William Forstner is opening up a gold mine in Siskiyou county, California.

M. Albertson has moved from Shreveport, Louisiana, to St. Louis, Missouri.

Frank G. Stevens, of Toronto, is visiting the Rex mine, Northern Manitoba.

Hugh Rose, manager of the Santa Gertrudis, at Pachuca, Mexico, has gone to London.

P. E. Calkins has been examining mines in Mohave county, Arizona, during the past month.

J. H. Hottendorf, recently at Yreka, California, is now with the Superior Dredging Co., at Bridgeport, Oregon.

Lester S. Grant, Dean of the Faculty in the Colorado School of Mines, is at Sonora, in Tuolumne county, California.

Bruce Marquand, recently metallurgist with the Sunnyside Mining Co., at Silverton, Colorado, is now at Berkeley, California.

Arthur E. Eddy has opened offices in the Electric building, at Billings, Montana, the firm of Eddy & Welsh having been dissolved.

Charles A. Mitke, of Bisbee, Arizona, recently addressed the Boston section of the A. I. M. & M. E. on the subject of mine-fires.

John W. Moule has resigned from the position of assistant resident manager for the Burma Corporation, Ltd., and is now in England.

Wallace Savage has resigned from the position of assistant editor of 'Chemical and Metallurgical Engineering' to enter private practice.

L. P. Barrett, geologist with the Michigan Geological Survey, has been examining mining properties in the Eureka mining district, Nevada.

R. C. Moore, geologist of the U. S. Geological Survey at Salt Lake City, is spending a few weeks in examination of gas and oil prospects in Kane and Garfield counties, Utah.

H. H. Stout, superintendent of the Copper Queen smelter at Douglas, has resigned and gone to New York, where he will continue to be associated with the Phelps Dodge Corporation.

H. V. Burgard, secretary of the Mineral, Metal & By-Products Co., has returned to San Francisco after visiting a number of gold and complex ore mines in several districts of California.

Harai R. Layng has resigned the superintendency of the Holly and Bullwhacker mines of the Eureka Holly Mining Co., and is now in private practice in San Francisco as a metallurgical engineer.

G. C. Greene, formerly research metallurgist for the Nevada Consolidated Copper Co., at McGill, Nevada, has accepted a position as engineer for the Copper Canyon Mining Co., at Battle Mountain, Nevada.

Victor C. Svimonoff, a prominent petroleum engineer of the Baku oilfields, formerly of the University of Pittsburgh, has recently returned from Russia, having escaped from the Bolsheviks. His temporary address is 370 West 120th street, New York.

Eastern Metal Market

New York, June 15.

An entire absence of improvement features in nearly all the markets, except possibly tin, and an easing in values is reported in most of the metals.

Buying of copper is no better than a week ago, either for export or domestic consumption.

Tin has been bought more liberally than any of the other metals.

Lead has been reduced in price and buying is limited to small quantities.

The zinc market is still lifeless.

IRON AND STEEL

So pronounced is the stagnation that the trade has given up hope that anything can be done to break the accentuated summer dullness, according to 'The Iron Age'. The continued excess of consumption over production is digging into stocks in consuming hands and some expansion in demand is expected in the early fall. The quick deliveries asked on many new orders indicate that stock balances are not being well maintained. Except for a further slowing down of operations, the week has been devoid of developments. Gaging the percentage of active producing capacity is difficult. It is doubtful if, for the industry as a whole, output is above 25%. The estimate for the Pittsburgh region is around 20%.

Price changes have been unimportant. The recessions, as in wire products, sheets, chain and cast-iron pipe, brought no better demand. Bidding for export business, small but conspicuous by comparison with the orders making up domestic sales, brings out price weakness.

The extent of the depression in the British industry is emphasized by the May production data. The pig-iron output was 13,634 tons and that of steel 5574 tons, against 60,300 tons of pig-iron and 68,400 tons of steel in April and a monthly average in 1920 of 667,325 tons and 754,733 tons respectively.

COPPER

No improvement is discernible nor is there prospect of it in the immediate future unless the foreign situation becomes better or the present depression at home shows some alleviation. Nevertheless there is not much pessimism in the copper trade. A fair consumption is reported, the sales for May having been not less than 110,000,000 lb. Production is getting smaller all the time so the net result is regarded as statistically favorable. Most producers are adhering to regular quotations of 13.50c. delivered, for June-July or are not quoting at all while a few, particularly one or two, will shade this to 13.12½ to 13.25c., delivered, but the quantity of metal available at these levels is small. Any demand would wipe out these concessions and values at once. For the business that is offered, and under the conditions, we quote the market for electrolytic copper at 13.25c., delivered, or 13c., New York, for early delivery, with Lake copper nominally about the same.

TIN

The market has been quite irregular the past week and consequently not easy to appraise, due largely to the fluctuations in sterling. Nevertheless there has been a fair amount of buying by both dealers and consumers. It is estimated that for the week ended with Friday or Saturday about 600 to 800 tons changed hands, but on the surface the market was decidedly quiet and not indicative of any activity. Monday of this week, June 13, there was further buying at 28.75c. for futures, with 29c. asked at the close for Straits

tin. Yesterday the quotation for spot Straits was 29.25c., New York, against 29c. a week ago. The London market has varied during the week, but yesterday quotations were £1½ to £2 per ton above those a week ago, with spot standard at £167 10s., future standard at £169 10s., and spot Straits at £168 per ton. Arrivals thus far this month have been 787 tons; 3000 tons is reported afloat.

LEAD

Another reduction has been made by the American Smelting & Refining Co. from 4.75 to 4.50c., both New York and St. Louis. This was actually put into effect last Friday, June 10, but not generally known until late Monday, June 13. There is no improvement in demand and the market is stagnant and featureless. On the basis of the outside market as representing actual business the market may be quoted at 4.50c., New York, or 4.25c., St. Louis.

ZINC

The market for prime Western is absolutely stagnant and values are a little lower. Wholesale lots for early delivery are quoted at 4.45c., St. Louis, or 4.95c., New York, which is 10 points under a week ago. The brass interests are doing almost no buying though their business is fairly good, but they are still using large quantities of scrap brass and adding special zinc for which there has been a good demand lately. Galvanizers are decidedly inactive, due to the depression in the steel industry, but when they buy it is for prompt delivery which is testimony to the effect that stocks of metal are very low.

ANTIMONY

Wholesale lots for early delivery are unchanged at 5.20c., New York, duty paid, with demand very light. Jobbing lots are quoted at 5.30 to 5.50 cents.

ALUMINUM

There has been no change in demand or prices. The leading producer continues to quote virgin metal at 28c. f.o.b. plant, in wholesale lots for early delivery, while other sellers quote the same grade of foreign make at 22.50 to 23.50c., New York.

ORES

Tungsten: Buyers are uninterested and prices are largely nominal and unchanged. Chinese ore can be bought at about \$3.25 per unit with Bolivian and domestic higher grade ores at about \$4 to \$4.25 per unit.

Ferro-tungsten is quoted at 48 to 58c. per pound of contained tungsten in lump form, guaranteed quality.

Molybdenum: The market is inactive and nominal at 50c. per pound of MoS₂ in regular concentrate.

Manganese: There is no demand with stocks heavy and importation large. Quotations are nominal at 22.50c. per unit, seaboard, for high-grade ore.

Manganese-iron Alloys: Demand is light for both ferro-manganese and spiegeleisen and quotations are unchanged. British ferro-manganese is quoted at \$75, seaboard, and the American alloy at \$80, delivered. Spiegeleisen is obtainable at \$30 to \$22, furnace. One consumer is asking bids on 500 tons and one lot of 100 tons was sold at close to the minimum figure.

Ferro-silicon, 50%, has sold at new low prices for recent years. It is stated that one seller has taken an order at \$74, delivered, against \$50 which recently ruled, while another seller will sell at \$69 to \$70 per ton, delivered, for early delivery.

THE METAL MARKET



METAL PRICES

San Francisco, June 21

Aluminum-dust, cents per pound.....	75
Antimony, cents per pound.....	6
Copper electrolytic, cents per pound.....	13
Lead, pig, cents per pound.....	4.75
Platinum, pure, per ounce.....	\$75
Platinum, 10% iridium, per ounce.....	\$105
Quicksilver, per flask of 75 lb.....	\$50
Spelter, cents per pound.....	0.50
Zinc-dust, cents per pound.....	9.00—0.50

EASTERN METAL MARKET

(By wire from New York)

June 20—Copper is inactive and lower. Lead is dull but easy. Zinc is stagnant and unchanged.

SILVER

Below are given official or ticker quotations for silver in the open market as distinguished from the fixed price obtainable for metal produced, smelted, and refined exclusively within the United States. Under the terms of the Pittman Act such silver will be purchased by the United States Mint at \$1 per ounce, subject to certain small charges which vary slightly but amount to approximately three-eighths of one cent. The equivalent of dollar silver (1000 fine) in British currency is 46.65 pence per ounce (925 fine), calculated at the normal rate of exchange.

Date	New York	London	Average week ending	Cents	Pence
June 14.....	59.00	35.82	May 9.....	61.58	35.08
" 15.....	58.37	35.00	" 16.....	60.41	34.42
" 16.....	58.00	34.82	" 23.....	58.93	33.40
" 17.....	58.37	34.87	" 30.....	58.15	33.00
" 18.....	59.00	35.25	June 6.....	57.08	33.75
" 19 Sunday.....			" 13.....	58.39	35.20
" 20.....	59.87	35.75	" 20.....	58.77	35.18

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.....	101.12	132.77	65.85	July.....	100.36	92.04	....
Feb.....	101.12	131.27	59.55	Aug.....	111.35	96.23	....
Mch.....	101.12	125.70	56.08	Sept.....	113.92	93.66	....
Apr.....	101.12	119.56	59.33	Oct.....	110.10	83.48	....
May.....	107.23	102.69	59.90	Nov.....	127.57	77.73	....
June.....	110.50	90.84	....	Dec.....	131.92	64.78	....

COPPER

Prices of electrolytic, in cents per pound.

Date	Average week ending	Cents	Pence
June 14.....	May 9.....	13.00	12.46
" 15.....	" 16.....	13.00	12.50
" 16.....	" 23.....	12.87	12.89
" 17.....	" 30.....	12.75	13.25
" 18.....	June 6.....	12.75	13.08
" 19 Sunday.....	" 13.....		12.91
" 20.....	" 20.....	12.75	12.85

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.....	20.43	19.25	12.94	July.....	20.82	19.00	....
Feb.....	17.34	19.05	12.84	Aug.....	22.51	19.00	....
Mch.....	15.05	18.49	12.20	Sept.....	22.10	18.75	....
Apr.....	15.23	19.23	12.50	Oct.....	21.66	16.53	....
May.....	15.91	19.05	12.74	Nov.....	20.45	14.63	....
June.....	17.53	19.00	....	Dec.....	18.55	13.18	....

LEAD

Lead is quoted in cents per pound, New York delivery.

Date	Average week ending	Cents	Pence
June 14.....	May 9.....	4.50	4.85
" 15.....	" 16.....	4.50	5.14
" 16.....	" 23.....	4.45	5.10
" 17.....	" 30.....	4.45	5.02
" 18.....	June 6.....	4.45	4.90
" 19 Sunday.....	" 13.....		4.75
" 20.....	" 20.....	4.45	4.47

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.....	5.60	8.65	4.96	July.....	5.53	8.63	....
Feb.....	5.13	8.88	4.54	Aug.....	5.78	9.03	....
Mch.....	5.24	9.22	4.06	Sept.....	6.02	8.08	....
Apr.....	5.05	8.78	4.32	Oct.....	6.40	7.28	....
May.....	5.04	8.55	5.01	Nov.....	6.76	6.37	....
June.....	5.32	8.43	....	Dec.....	7.12	4.76	....

TIN

Prices in New York, in cents per pound.

	1919	1920	1921		1919	1920	1921
Jan.....	71.50	62.74	35.94	July.....	70.11	49.29	....
Feb.....	72.44	59.87	35.16	Aug.....	62.20	47.60	....
Mch.....	72.50	61.92	28.87	Sept.....	55.79	44.43	....
Apr.....	72.50	62.17	30.36	Oct.....	54.82	40.47	....
May.....	72.50	54.99	32.50	Nov.....	54.17	30.97	....
June.....	71.83	48.33	....	Dec.....	54.94	34.12	....

ZINC

Zinc is quoted as spelter, standard Western brands, New York delivery, in cents per pound.

Date	Average week ending	Cents	Pence
June 11.....	May 9.....	4.95	5.15
" 15.....	" 16.....	4.95	5.41
" 16.....	" 23.....	4.95	5.35
" 17.....	" 30.....	4.95	5.25
" 18.....	June 6.....	4.95	5.17
" 19 Sunday.....	" 13.....		4.98
" 20.....	" 20.....	4.95	4.95

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.....	7.44	9.50	5.80	July.....	7.78	8.18	....
Feb.....	6.71	9.15	5.34	Aug.....	7.81	8.31	....
Mch.....	6.53	8.93	5.19	Sept.....	7.57	7.84	....
Apr.....	6.49	8.76	5.33	Oct.....	7.82	7.50	....
May.....	6.43	8.07	5.37	Nov.....	8.12	6.78	....
June.....	6.91	7.92	....	Dec.....	8.69	6.03	....

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, according to quantity. Prices, in dollars per flask of 75 pounds.

Date	Average week ending	Dollars	Pence
June 21.....	June 7.....	50.00	50.00
May 31.....	" 14.....	50.00	50.00
	" 21.....	50.00	50.00

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.....	103.75	80.00	50.00	July.....	100.00	88.00	....
Feb.....	90.00	81.00	48.75	Aug.....	103.00	85.00	....
Mch.....	72.80	87.00	45.88	Sept.....	102.60	75.00	....
Apr.....	73.12	100.00	46.00	Oct.....	86.00	71.00	....
May.....	84.80	87.00	50.00	Nov.....	78.00	56.00	....
June.....	94.40	85.00	....	Dec.....	05.00	52.50	....

OIL IN SOUTH AMERICA

That Colombia will soon be one of the leading oil countries in South America is indicated in a report on the oil industry of that continent by J. W. Thompson, of the United States Bureau of Mines. He says that South American fields are admirably situated for distribution of petroleum by water to all nations using oil as fuel for shipping and industrial concerns.

According to the report, the International Petroleum Co., a Standard Oil subsidiary, is spending more than \$25,000,000 on development of the De Mares concession in the heart of Colombia, which it purchased from the Tropical Oil Co. This concession contains 1,300,000 acres and has three producing wells. A six-inch pipe-line has been laid to a refinery at Barranca Bermeja. A railroad and a tractor road are being constructed. The company has also purchased an island at the mouth of the Magdalena river on which it plans a refinery, ultimately to have a capacity of 25,000 bbl. daily. It is also laying a pipe-line from De Mares concession, 300 miles up the river, to tide-water, at a probable cost of \$3,000,000.

Concessions have been obtained in Colombia by various interests and wells drilled farther up and lower down the Magdalena river and in large numbers along the coast about Gulf of Darien. From Honda, on the upper Magdalena, north and north-easterly some 650 miles to Lake Maracaibo, in Venezuela, there is now almost a continuous line of concessions.

Regarding the oil industry of Venezuela, the report says oil concessions and their development are confined principally to territory bordering Lake Maracaibo, and concessions have been granted for about 75% of the land immediately around the lake. British and American companies are active, and in 1920 eight wells were completed at an average depth of 1,200 ft., producing a total of about 6000 bbl. daily. Four wells of the Colon Development Co., owned by the Royal Dutch-Shell-Carb Syndicate interests, have a daily capacity of about 4000 barrels.

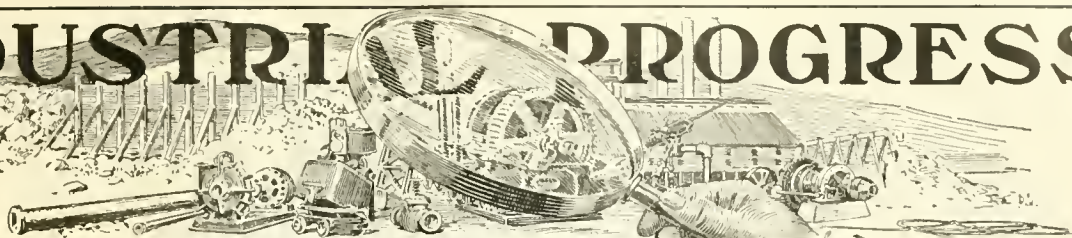
Argentine production is running more than 25,000 bbl. per week, according to an official estimate. There is a disposition to grant private interests the right of participation in development of Argentine fields, and British and American interests are active. Big concessions have been granted in Bolivia, without any guaranty of early development. There are several districts in Brazil where oil indications are promising, and Brazilians or foreigners residing in Brazil may operate under license granted upon application. There have been no important oil discoveries in Chile so far as known, although surface manifestations have been found. Exploitation is permitted under license. A change in petroleum laws of Ecuador is regarded as indispensable for encouragement of the oil industry. Nevertheless, a British company is endeavoring to acquire rights over 60,000 acres on Santa Helena peninsula. Peru is one of the pioneer countries in oil development of South America. In 1913 production was 2,071,000 bbl. At the beginning of 1920 the annual production was estimated at 2,500,000 bbl. A large amount of refined products is exported from Peru, there being a substantial refining industry. An exportation tax of one shilling per metric ton is imposed on petroleum and its products.

MONEY AND EXCHANGE

Foreign quotations on June 21 are as follows:

Sterling, dollars: Cable.....	3.76 1/4
Demand.....	3.77 1/2
Francs, cents: Cable.....	8.12
Demand.....	8.14
Lire, cents: Demand.....	5.07
Marks, cents.....	1.51

INDUSTRIAL PROGRESS



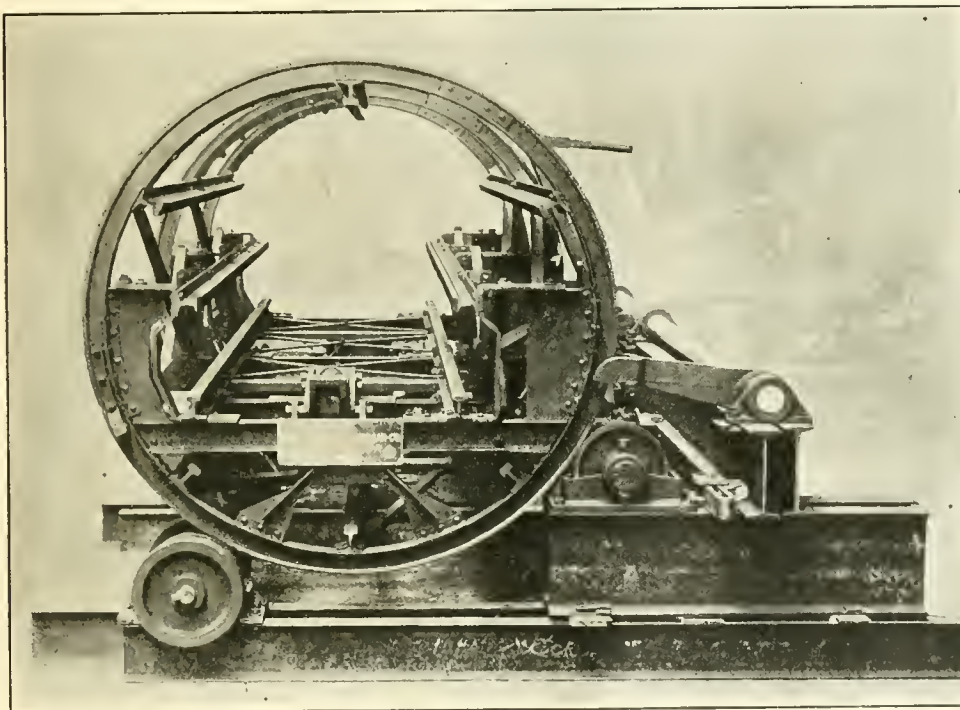
INFORMATION FURNISHED BY MANUFACTURERS

THE 'ROLLSRIGHT' CAR TIPPLE

By A. G. Reese

Various types of rotating car tipples are used for dumping mine-cars, the source of power being compressed air, steam, or electricity. Rotary car-tipples have many advantages over the end-dump type, as cars without dump-bottom or end-gates can be used. This feature eliminates largely any scattering of material along the haulageways which is characteristic of any other type of car, and also

the top of the slope the cars enter either of the two 'Rollsright' car tipples which are placed over a 300-ton pyramidal bin. The average capacity of this mine is 1500 tons in 8 hours. At No. 3 Dolomite mine are situated two five-car 'Rollsright' tipples. The cars at this mine are brought to the face of the slope by electric locomotive and there made up in trains of five, which are hauled up a 30° slope 1400 ft. long at a speed of 2000 ft. per minute by a 700-hp. double-drum electric hoist. The 'Rollsright' tipples are set at an angle of 15° over a 400-ton double bottom V-shaped bin. The cars at both the Dolomite mines are dumped without detaching from the hoist-rope. Both of the above described tipples are used for coal, the weight of each loaded car being 4600 pounds.



'Rollsright' Car-Tipple

eliminates the trouble due to accidental opening of doors when cars are traveling at high speed.

Solid type cars are lighter, cost less for repairs, are more rigid, have longer life, and lower initial cost. The Wellman-Seaver-Morgan Co. has placed on the market an entirely different type of rotating tipple in that it does not require any power for operation except that furnished by the car itself; this results in many advantages principally as follows: simplicity of construction, the result of which is lower first cost; simplicity of operation which allows the employment of unskilled labor; lower maintenance charges; and increased production.

There are now several of these tipples in operation, the first one being at a coal-mine adit known as Dolomite No. 1 of the Woodward Iron Co., at Birmingham, Alabama. The coal-cars, after being brought to the foot of the slope by an endless rope, are attached in sets of four to the tail-rope and hoisted at a speed of 1500 ft. per minute up a double-track slope 1900 ft. long having a maximum grade of 26°. At

For the installations described above swivel car-couplings are not used, as the entire train is dumped at one operation. The 'Rollsright' tipple can be applied also to conditions where it is desired to dump a number of cars without detaching them from the remaining train.

The general description of the 'Rollsright' is as follows: The tipple will dump one or any number of cars at one time and will make a complete dumping cycle in five to seven seconds.

It is controlled entirely by one latch-lever which holds the tipple in upright position. The centre of gravity of the loaded car or cars is 'off centre' of the tipple sufficiently that when released by latch-lever the tipple rotates through an arc of about 135°, setting in motion a set of flywheels situated on the roller shafts. At the end of the 135° arc the tipple ring engages with a specially designed spring and wedge, which stops the forward motion of the tipple. The centre of gravity of the car or cars is now on the opposite side of the centre line of tipple. This feature in connection with the recoil action of the springs starts the tipple in the opposite direction and brings the flywheels up to speed, their momentum carrying the tipple around to its original position where it automatically latches. All the rollers which support the tipple are carried on shafts mounted in Hyatt roller bearings which reduce friction to a minimum.

AN ANNIVERSARY

On June 25 the Robins Conveying Belt Co. celebrated its twenty-fifth anniversary. The organization was founded on June 25, 1896, to develop an idea—the handling of material by means of the belt-conveyor. Twenty-five years ago

Industrial quantities were small. The largest conveyor then in existence, made of chain and steel plate, carried 200 tons per hour. The belt conveyor, then a new thing, was laughed at by many engineers who refused to believe that rubber excelled steel in resisting abrasion, but when this was found to be so, and the belt conveyor was demonstrated to be a durable and economical device of enormous capacity, engineers quickly adopted it, and a tenfold increase in industrial quantities has been very largely due to its employment. The engineer of today can handle two or three thousand tons per hour more easily than one tenth of such quantities was formerly moved.

In a thousand industries the belt conveyor is an efficient link between processes. Formerly it was necessary to fit conveyors into existing plants, but today the handling of material is such a controlling element that the requirements of the conveying system usually determine the situation and arrangement of the buildings. Pioneers in the handling of large quantities, the Robins company has developed many systems and devices for the treatment and storage of materials. These include car-dumpers, unloading-towers, storage-bridges, self-unloading vessels, and steel structures of all kinds. The company also manufactures large and small castings, gearing, screens, and power-transmission machinery.

COMMERCIAL PARAGRAPHS

The Denver Quartz Mill & Crusher Co., of Denver, is shipping a carload of machinery including a No. 2 Denver quartz mill to the McCue brothers, Dutch Guiana, where it will be used in the milling of gold ore.

Atlas-Chalmers Manufacturing Co. has issued Bulletin No. 1117, entitled 'Small Generating Sets'. These are particularly well suited for isolated lighting and power-plants where steam is available as the prime source of power.

Bulletin No. 5, entitled 'Victor Damper Regulator, No. 3, High Pressure', has been issued by the Atlas Valve Co. This regulator is designed for boiler pressures up to 250 lb. The damper control-cylinder is operated in both directions by water-pressure admitted through a pilot valve. The compensating attachment limits the travel of the control cylinder on intermediate pressure changes and permits the regulator to fully open or close the damper only on extreme pressure variations.

The Chicago office of the Uehling Instrument Co. of New York, manufacturer of fuel-saving equipment, was moved May 1 to the Great Northern building, 20 West Jackson boulevard. Walter C. Lange, who has been appointed manager of this office, is well qualified to co-operate with power-plant operators in solving problems of fuel conservation because of his former experience in this field. Uehling 'CO.' recording equipment and other boiler-room instruments will be on display in the new office.

Curtis steam turbines of 100-kw. to 3500-kw. capacity have been developed for driving 60-cycle generators at 3600 r.p.m., according to Bulletin No. 42201-B, issued by the General Electric Co. These units are adapted for industrial and lighting plants requiring economical and reliable generation of electric power. As no internal lubrication is necessary, and as the oil is circulated through the bearings in a closed system, the cost of oil is small. The cost of attendance is also small, and, on account of the simple and strong construction, the cost of repairs is low. Under maximum working conditions, steam may be extracted from a Curtis turbine for heating and manufacturing purposes. The steam, which passes through all stages of the turbine to the condenser, is used at the same high efficiency as in a turbine from which no steam is extracted.

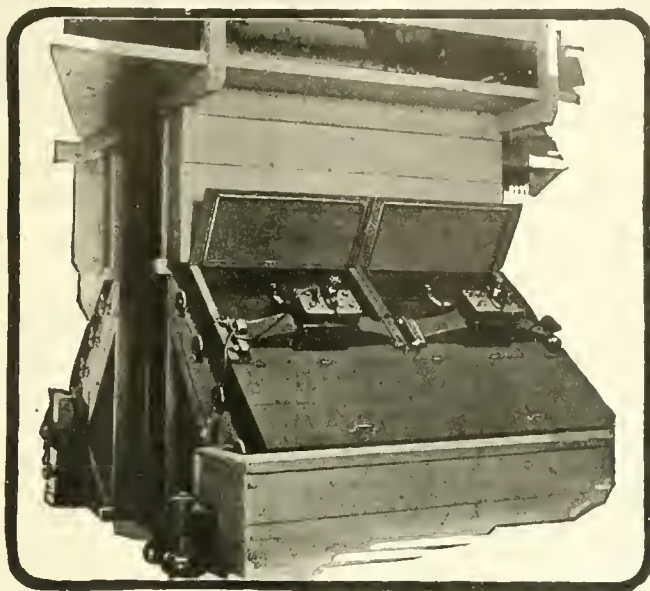
The Hauck Manufacturing Co., of Brooklyn, manufacturers of oil-burners, oil-forges, oil-burning appliances, etc.,

has elected as its president, Henry T. Gordes, mechanical engineer and manufacturer of New York; first vice-president, M. C. Hauck; second vice-president, A. H. Hauck; third vice-president, H. H. Kress; treasurer, A. H. Stein; secretary, J. Luiz. H. T. Gordes, who succeeds the late Arthur E. Hauck, is well fitted for his new position. He is a graduate of Stevens Institute of Technology. He has a practical knowledge of the manufacture of oil-burning torches and appliances.

In addition to reducing its prices, on June 1, the Hercules Powder Co. announced that it had developed formulae—the result of exhaustive studies and experiments—which have enabled it to discontinue the manufacture of high freezing dynamites without sacrificing any desirable features which the older grades possessed. This means that Hercules 'Extra' and 'G. Latin' dynamites, 'Hercules Special No. 1', and 'Hercocomite', and most of the 'Straight Nitroglycerin' dynamites and 'Red It' permissible explosives can now be used without the wing under all temperature conditions that are found in practically any blasting work.

The Pawling & Harnischfeger Co., of Milwaukee, has designed and improved a safety cage for traveling cranes. Space is always at a premium in crane-cabs, and for this reason exposed knife-switches, magnetic-control parts, and resistors introduce a serious hazard. In previous P & H crane-cages a false bottom in the cab was provided for the resistors, greatly simplifying the upper part, but now by providing front lever control and placing the entire control equipment and current-carrying parts in an enclosure, a maximum of safety is provided. The levers which operate radiating (backward and forward) are placed at the front of the cage to afford the operator an entirely unobstructed view. He can see the position and movement of the crane hook, the signals of floor-men, and the entire floor as the crane travels along the runway. Crane operators prefer the radial motion of control-levers to the 'coffee-mill' movement previously employed. The crane operator can by no chance come in contact with live parts, even the main knife-switch is operated from the exterior of the cabinet. Opening the hinged doors exposes all parts for inspection and adjustment. The rear-of-board wiring is accessible by removal of an enclosing panel at the rear. This new cage has been in actual operation on a number of cranes and performance watched for the past year before standardizing.

The General Electric Co. has standardized a complete line of 60-cycle synchronous condensers, for power-factor control, to meet the demand for a comparatively inexpensive high-speed machine. These condensers are described in Bulletin No. 41311-A, superseding Bulletin No. 41311, entitled 'Synchronous Condensers'. These machines are of light mechanical construction and possess other features which permit a reduction in the amount of material required and a consequent lower cost, without lessening their value as synchronous condensers. The standard machines are designed for operation on 480, 600, and 2300 volts in the smaller sizes; 2300 volts in the intermediate sizes, and 6600 and 13,200 volts in the larger sizes. Several advantages of making the synchronous condenser an integral part of a power-system, for power-factor control, are cited by the bulletin. These involve the total cost of the equipment required to handle a given load, the regulation of long high-voltage transmission lines, additional load which can be carried, and the increased operating efficiency which is possible. The bulletin also describes the use of automatic starting and control equipment for synchronous condensers in cases where it is not always possible to have attendants; and the use of these machines to drive a mechanical load. Calculations necessary in figuring on a synchronous condenser installation, a wiring diagram, and other data are included in the bulletin.



\$0.00148 Per Ton!

cost of operating

Four Hum-mer *Electric Screens*

at one of the largest copper mines in the United States

The figures below were compiled by the
Supt. of Concentrators after a 6-months run.

		% of Total
Labor for 6 months ending Dec. 1, 1920.....	\$419.08	58.5
Supplies for 6 months ending Dec. 1, 1920.....	168.67	23.6
Power for 6 months, 6405 K. W. @ 2 cents.....	128.10	17.9
Total	\$715.85	100.0
Total dry tons milled and screened during period.....	483,399	
Cost of screening per dry ton milled.....	\$0.00148	

"I am pleased to say that we have recently completed a prolonged test on our "Hum-mer" screen installation.

"Our ore carries practically a uniform moisture of 3.5%.

"The feed to the screens is crushed through one inch, practically all through three-quarter inch, and the screening is done dry. We de-

sire a 4 mesh undersize product for primary table treatment.

"Feed is delivered at the rate of 4200 dry tons per 24 hours by a conveyor above the screens and is evenly divided by two steps. At the head of each screen, the feed is retarded and spread by a suspended, weighted gate.

"In general I will say that we are entirely satisfied with the work of the screens."

Superintendent of Concentrators.



The Hum-mer Electric Screen can be used to screen any material—
wet, damp or dry. Send for Catalogue No. 42-M

THE W. S. TYLER COMPANY

CLEVELAND, OHIO

Manufacturers of Woven Wire Screens and Screening Equipment



OPPORTUNITY PAGE



OPPORTUNITIES

Under this heading announcements may be made of new and second hand machinery or supplies, for sale or wanted. The cost is 3 cents per word, including address. Minimum charge one dollar per insertion. Remittances must accompany order. Copy must be received by Saturday for the following week's issue.

ENGINEERING REPORTS SCIENTIFICALLY TYPED PUBLIC stenographer, multigrapher and translator; French, German, Italian, Spanish. Confidential service, quality, punctuality, economy; estimates furnished. Address Olvera Herz offices First National Bank Bldg and Holbrook Bldg., San Francisco, California. Phone Garfield 9416. eow-11

FOR SALE—Drilling plant, including 80 cu. ft. vertical air compressor, 24x5 receiver, kerosene engine, hammer drill, two sets steel, all fittings, valves, pipes, belts, gauges, and everything ready to run; outfit is NEW, having never been used. We can also fit you out with crushers, rolls, hoists, and various other mining equipment. U. S. Iron Works, Seattle, Wash. eow-11

OPPORTUNITY—Diamond drilling on a new basis of cost, saving you one-half to one-quarter over present methods. Guaranteed work with best up to the minute equipment, efficient and experienced help. Long experienced and enthusiastic customers. Write for information. H. D. Staley, 229 Lick Bldg., San Francisco. 11

FOR SALE—The Belcher gold quartz, patented, mining location, three miles from Southern Pacific Railroad and Lincoln highway, Cisco, California. Known in '65 as the Enterprise, when a small surface quarry yielded large returns of high grade gold sulphides, which were shipped to Swansea smelter for extraction; it has not been worked since; includes seven adjoining claims. Reasons for selling, old age and distance from our home. Address Theodore Robinson, 7 Fairwoods Road, Madison, N. J. 8-27

WANTED—To buy brick-lined revolving furnace, length 12-20 feet, inside diameter about 3 feet; give particulars, price, location, condition. Address Opp 656, Mining and Scientific Press. 6-25

NEW YORK ENGINEERING CO.

2 Rector Street

New York

GOLD AND TIN DREDGES

"Empire" Prospecting Drills
Placer Mining Machinery

Write for Catalogs

LUFKIN

Backed by a record of 25 years
of dependable service
CATALOG ON REQUEST

THE LUFKIN RULE CO.

Measuring
Tapes and
Rules

Saginaw,
Mich.
New York



MARC L. LATHAM

Angels Camp, California

PIPE CASING — VALVES — FITTINGS

Used and New. Tested and Guaranteed.

PACIFIC PIPE COMPANY

233 Howard Street

San Francisco, Cal.

Rocks and Rock Minerals

By L. V. PIRSSON

414 Pages

36 Full Page Plates

Cloth

Price \$3.00

MINING AND SCIENTIFIC PRESS

120 Market St., San Francisco

THE STEARNS-ROGER MFG. CO.

ENGINEERS
MANUFACTURERS
CONTRACTORS

DENVER, COLO.

MINING AND
MILLING MACHINERY
AND PLANTS

OPPORTUNITY PAGE

POSITIONS WANTED

The cost of advertising for positions wanted is 2 cents per word, including address. Minimum charge 50 cents per insertion. Replies forwarded without extra charge. Remittances must accompany order. Copy must be received Saturday morning for the following week's issue.

ENGINEER SALESMAN wants position where long and varied foreign and domestic experience can be utilized by an exporting firm to build up overseas trade. Familiar with heavy machinery, mining, milling and allied industry supplies. Address PW 658, Mining and Scientific Press. 7-23

MINING ENGINEER, specialist in difficult ore dressing problems, wants position; good on investigations, reports, etc.; best of references; will go anywhere; fluent Spanish. Address PW 657, Mining and Scientific Press. 7-23

ENGINEER AND MACHINIST, also good draftsman; have had experience with steam and Diesel engines, also electricity; can solve any power plant or machine shop trouble; can design anything in power or plants; whether position as engineer or machinist can take charge of plants; prefer Central or South America mining, marine or manufacturing company. Address PW 652, Mining and Scientific Press. 7-9

SUPERINTENDENT OR ENGINEER, technical graduate, 10 years successful experience in mining, milling and exomation. Speak Spanish; available on thirty days notice. At present in Mexico. Address PW 651, Mining and Scientific Press. 7-2

CHIEF ENGINEER, age 40, married; experience covers 21 years; 17 years chief engineer of gas, steam and Diesel electric plants, also large pumping plants; speak Spanish and understand Mexican people. Mexico, Central or South America preferred. Address PW 644, Mining and Scientific Press. 7-2

POSITION as working master mechanic at small or medium size mine. Thorough machinist and electrician; experienced mine and mill machinery; practical knowledge of mining; initiative with the ability to make things go. Age 41. Address PW 646, Mining and Scientific Press. 11

MINING ENGINEER, TECHNICAL GRADUATE. Thorough experience in development, operation and construction. Speak Spanish. Married. Age 33. Address PW 653, Mining and Scientific Press. 6-25

1884 DRILLING The Oldest and Largest Firm 1921 CONTRACTORS
DIAMOND DRILL ENGINEERS
SULLIVAN MACHINERY CO.
580 MARKET ST., SAN FRANCISCO

DREDGES FOR GOLD AND TIN

UNION CONSTRUCTION CO.

604 Mission St., San Francisco, Cal.

Neill Jigs

Union Churn Drills

CARS TRACK SWITCHES
KOPPEL INDUSTRIAL CAR & EQUIP. CO.
KOPPEL, PA.

SINTER YOUR FINE ORES

Special Problems in Ore Treatment

DWIGHT & LLOYD SINTERING CO.

29 Broadway

Cable Address: Sinterer

New York City

POSITIONS AVAILABLE

Announcements in this column are secured through the co-operation of many of the largest mining companies in the United States. Advertisements under this heading will be inserted two times without charge. Additional insertions charged at the rate of 2c. per word, including address.

WANTED—Engineer experienced in installation of electrical and mining machinery; speaking Spanish; temperate climate; contract for one year at \$150 per month; extension of contract for two years more if mutually satisfied; traveling expenses and board paid. Send applications to the Colombian Corporation Ltd., Medellin, Colombia, South America. 7-2

WANTED FOR CYANIDE MILL IN NEVADA—strike conditions—men familiar with the operation of a modern cyanide plant. Mill consisting of stamps, tube mills, agitating and thickening equipment, and Butters filter. Refinery helper and crusher foreman familiar with gyratory crushers and conveyor equipment. Employment permanent. Address all communications to P.A. 654, Mining and Scientific Press. 6-25

SPECIALTY SALESMEN to handle a good line of labor-saving devices for mines on commission; no objection to carrying a side line; fast sellers; write for terms. The American Mine Door Company, 922 Robin St., Canton, Ohio. 6-25

NEW BRAZILIAN MINING LAW

Edict of January 1921

English Copies For Sale

SOUTH AMERICAN MERCANTILE BUREAU

Translators, Advisers, Adjusters

80 Maiden Lane, New York

Telephone: John 5416

7-2

WANTED GOLD DREDGER

(Not larger than 6-foot)

—BY—

The California Cariboo Gold Dredging Company
401 Markwell Building, Long Beach, Cal.

Will pay cash. Dredger must be in good condition and suitable for 35-foot depth. Give particular type of Dredger and where machine can be seen.

ALTERNATING CURRENT GENERATORS

- 30 KW. General Electric, 360 2300 volts, 1200 R.P.M., with 1 KW belted exciter, switchboard and instruments.
- 75 KVA. Fairbanks Morse, 360 2300 volts, 1200 R.P.M., with 2 1/2 KW belted exciter.
- 75 KW. Westinghouse, 360 110 volts, 500 R.P.M.
- 90 KW. General Electric, 360 2300 volts, 1200 R.P.M., with 3 KW. belted exciter, switchboard and instruments.
- 150 KW. Westinghouse, 360 100 volts, 1200 R.P.M.
- 200 KW. Westinghouse, 360 110 volts, 200 R.P.M., revolving field, belted exciter, switchboard and instruments.
- (2) 250 KW. General Electric, 330 1000 volts, 112 1/2 R.P.M., revolving field, belted exciter, switchboard and instruments. Also 300 KW. General Electric, 330 1000 volts, 112 1/2 R.P.M., revolving field, belted exciter, switchboard and instruments.
- 300 KW. Westinghouse, 360 110 volts, 500 R.P.M., with 10 KW. belted exciter, switchboard and instruments.

THE MORSE BROS. MACHINERY & SUPPLY CO.
DENVER, COLORADO

PROFESSIONAL DIRECTORY

RATES: One-half inch, \$25 per year, subscription included. Combination rate with The Mining Magazine (London), one-half inch in each, \$40 per year, subscription included

ABRAHAMSON, Hjalmar

518-28 U S Nat'l Bank Bldg., Denver, Colo.
No professional work undertaken

BATTEN, H. L.

MINING ENGINEER
614 Pender St. W., Vancouver, B. C.
Cable: Alamorg Code: Bedford McNeill

BROWN, R. Gilmor

CONSULTING ENGINEER
Pinners Hall, London, E.C. 2
Cable: Argeby Usual Codes

ADDICKS, Lawrence

CONSULTING ENGINEER
51 Maiden Lane, New York City
Cable: Galle, New York

BEADON, W. R. Coleridge

MINING ENGINEER
P O Box 103, Rangoon, Burma
Cable: % Scott, Rangoon

BROWNE, Spencer C.

MINING ENGINEER
2 Rector Street, New York
Cable: Spenbrowne, New York

AGUILAR-REVOREDO, J. F.

CONSULTING MINING ENGINEER
Examination, valuation and development of
mines in Bolivia
Casilla 178, Oruro, Bolivia

BEAM, A. Mills

METALLURGICAL AND CONSULTING
ENGINEER
807 Central Savings Bank Bldg.,
Denver, Colorado

BURCH, Albert

CONSULTING ENGINEER
Crocker Bldg., San Francisco
Cable: Burch Usual Codes

ALDRIDGE, Walter H.

MINING AND METALLURGICAL ENGINEER
50 East 42nd St., New York

BEATTY, A. Chester

CONSULTING MINING ENGINEER
25 Broad St., New York
No professional work entertained
Cable: Gramtic

BURCH, H. Kenyon

CONSULTING ENGINEER
Phelps Dodge Corporation,
Copper Queen Branch
Bisbee, Arizona

ARNOLD, Ralph

GEOLOGIST AND PETROLEUM ENGINEER
Union Oil Bldg., Los Angeles, Cal.
120 Broadway, New York
Cable: Ralfarnoil Code: Bedford McNeill

BEAUCHAMP, F. A.

METALLURGIST
Specialty: Flotation
419 Embarcadero, San Francisco

BURGER, C. C.

MINING ENGINEER
71 Broadway, New York

AUSTIN, WILSON & GAMBLE

MINING ENGINEERS
316 Kohl Bldg., San Francisco
Cable: Austin Usual Codes

BEDFORD, Robert H.

MINING ENGINEER
Grass Valley, California

BURGESS, John A.

MINING ENGINEER AND GEOLOGIST
618 Mills Bldg., San Francisco, Cal.

BAIN, H. Foster

DIRECTOR U. S. BUREAU OF MINES
Washington, D. C.
Cable: Mobsu Code: Broomhall

BELLINGER, H. C.

METALLURGICAL ENGINEER
% Chile Exploration Co.
120 Broadway, New York

CALLOW, J. M.

Pres. General Engineering Co.
CONSULTING METALLURGICAL ENGRS.
Room 3022, No. 120 Broadway, New York
159 Pierpont St., Salt Lake City, Utah, U.S.A.

BALL, Sydney H.

MINING GEOLOGIST
42 Broadway, New York
Cable: Alhastars Rogers, Mayer & Ball

BLANKINSHIP, J. W., Ph.D.

CONSULTING PLANT-PATHOLOGIST
Specialty: Smoke and Other Industrial Injury
to Vegetation. 14 years experience in America
and Europe. 2525 Hilgard Ave., Berkeley, Cal.

CAMPBELL, J. Morrow

MINING GEOLOGIST AND ENGINEER
Messrs. Steel Bros. & Co., Ltd.,
Rangoon, Burma

BANCROFT, Howland

CONSULTING MINING GEOLOGIST
408 Crocker Bldg., San Francisco
Casilla No. 215, Oruro, Bolivia
Cable: Howban Code: Bedford McNeill

BOISE, Charles W.

MINING ENGINEER
Foreign Exploration
Room 1507, 14 Wall Street, New York
Cable: Mukaba

CARPENTER, Alvin B.

MINING ENGINEER
Citizens National Bank Bldg., Los Angeles

BANKS, Charles A.

MINING ENGINEER
612 Pacific Bldg., Hastings St. W.,
Vancouver, B. C.
Cable: Banca Code: Bedford McNeill

BOSQUI, Francis L.

METALLURGICAL ENGINEER
342 Madison Ave., New York

CHANCE & CO., H. M.

COAL MINING ENGINEERS IRON
839 Drexel Bldg., Philadelphia

BARBER, Ray J.

MINING ENGINEER
Burlingame, California

BOTSFORD, R. S.

MINING ENGINEER
Room 2083, No. 50 Church St.,
New York City, U. S. A.

CHANNING, J. Parke

CONSULTING ENGINEER
61 Broadway, New York

BARKER, Edgar E.

MINING ENGINEER
Morococha, Peru

BRAYTON, Corey C.

MINING ENGINEER
2937 Magnolia Ave., Berkeley, Cal.

CHASE, Charles A.

MINING ENGINEER
825-826 Cooper Bldg., Denver
Liberty Bell G. M. Co., Telluride, Colo

BARLING, H. B.

MINING ENGINEER
7 and 9 Hanover St., Marquette, Mich.
New York Code: McNeill

BRODIE, Walter M.

MINING ENGINEER AND METALLURGIST
47 Cedar St., New York

CHASE, E. E. and R. L.

MINING AND GEOLOGICAL ENGINEERS
207 Colorado Nat. Bk. Bldg.,
Denver, Colo

COHEN, Samuel W.
CONSULTING MINING ENGINEER
Dominion Express Bdg., Montreal, Canada

COLBRAN, Arthur H.
MINING ENGINEER
Seoul, Korea

COLLINS, Edwin James
MINING ENGINEER
Mine Examinations and Management
100S-1009 Torrey Bdg., Duluth, Minn.

COLLINS, George E.
MINING ENGINEER
Mine Examinations and Management
307 Boston Bdg., Denver
Cable: Colomac

**COLLINS, GLENVILLE A.,
ENGINEERS, LIMITED**
MINING ENGINEERS
Cable: "Glencolins" Vancouver, B. C.

COLLINS, Henry F.
MINING AND METALLURGICAL ENGINEER
66 Finsbury Pavement, London, E.C.

COLLINS, W. F.
CONSULTING MINING & METALLURGICAL
ENGINEER
Cable: Collins, Peking Peking, China

COOK, Paul R., E.M.
MINING ENGINEER — BALKAN STATES
Care American Consul
Sofia, Bulgaria — Belgrade, Serbia

CRANSTON, Robert E.
MINING ENGINEER
1213 Hobart Bdg., 582 Market St.
San Francisco 2 Rector St., New York
Cable: Recrans Code: McNeill 190S

DARLING, Harry W.
MINING ENGINEER
Box 489, 24 N. Chapel St.,
Timmins, Ont., Canada Alhambra, Cal., U.S.A.

DAVIS, Leverett
MINING ENGINEER
Examination, Development, Management
911 Foster Bdg., Denver, Colo.

DAY COMPANY, THE
PETROLEUM AND OIL SHALE ENGINEERS
414 Hobart Bdg., San Francisco, Cal.

DEFTY, W. E.
MINING ENGINEER
618 North Third Avenue
Phoenix, Arizona

DEZ MAR, Algernon
MINING ENGINEER AND METALLURGIST
Specialty, Mill Operation and Construction
1424 Alpha St., Los Angeles

**DEWEY, STRONG,
TOWNSEND & LOFTUS**
PATENT ATTORNEYS
909-917 Crocker Bdg., San Francisco

DENNIS, Clifford G.
MINING ENGINEER
Crocker Bdg., San Francisco
Cable: Sinned Code: McNeill

DICKERMAN, Nelson
MINING ENGINEER
The Insurance Exchange, San Francisco
Cable: Deerhodor Code: McNeill 190S

DOLBEAR, Samuel H.
CONSULTING MINING ENGINEER
1415 Merchants National Bank Bdg.,
San Francisco

DORR COMPANY, THE
John V. N. Dorr, President
HYDROMETALLURGICAL AND WET CHEM-
ICAL ENGINEERS
Denver New York London, E.C.

DUDLEY, H. C.
MINING ENGINEER
704 Lonsdale Bdg., Duluth, Minn.

DWIGHT, Arthur S.
MINING ENGINEER AND METALLURGIST
29 Broadway, New York
Cable: Sinterer Code: McNeill; Miners & Smelters

EASTON, Stanly A.
MINING ENGINEER
Manager Bunker Hill & Sullivan Mining &
Concentrating Co., Kellogg, Idaho

EDE, J. A.
CONSULTING MINING ENGINEER
La Salle, Illinois

ELFTMAN, A. H.
MINING GEOLOGIST AND ENGINEER
1209 Hobart Bdg., 406 State Bank Bdg.,
San Francisco, Cal. Tonopah, Nevada

EYE, Clyde M.
MINING AND METALLURGICAL ENGINEER
% Wells Fargo Nevada Nat. Bank,
San Francisco, Cal.
Cable: Eyecon Code: Western Union

FARISH, C. S. T.
MINING ENGINEER
Soc. Min. Backyus y Johnston del Peru
Casapalca, Peru, S. A.

FARISH, George E.
CONSULTING MINING ENGINEER
First National Bank Bdg., San Francisco
25 Broad St., New York

FARISH, John B.
MINING ENGINEER
Office, 58 Sutter St., San Francisco
Residence, San Mateo, Cal.
Cable: Farish

FINLAY, J. R.
MINING ENGINEER
Room 1410, 170 Broadway, New York

FITCH COMPANY, Walter Jr.
SHAFT AND TUNNEL CONTRACTORS
Zurcka, Utah

FISHER & LOWRIE
CONSULTING GEOLS. AND FUEL ENGRS.
1st Nat. Bk. Bdg., Denver. 423 Broad St., New
York. 826 Great Southern Bdg., Dallas, Tex.
Cable: Calfishoil Usual Codes

FOWLER, Samuel S.
MINING ENGINEER AND METALLURGIST
Nelson, British Columbia
Cable: Fowler Usual Codes

FRAME, James
MINING ENGINEER AND GEOLOGIST
Room 607, 53 State Street,
Boston, Mass.

FREITAG & AINSWORTH
DESIGNING AND CONSTRUCTING ENGRS.
Mine and Metallurgical Plant Design and
Construction
1209 Hobart Bdg., San Francisco

GAHL, Rudolf
CONSULTING METALLURGIST
804 Equitable Bdg., Denver, Colo.

GARLICK, William A.
Attorney at Law
Certified Public Accountant (N. C.)
SPECIALTY: INCOME TAX LAW
As Applied to Oil, Mines and Timber
410 Crocker Bdg., San Francisco, Cal.

GARREY, George H.
CONSULTING MINING GEOLOGIST AND
ENGINEER
Bullitt Bdg., Philadelphia, Pa.

GEPPERT, Richard M.
MINING ENGINEER
% Mining Magazine,
Salisbury House, London, E.C.

GIBSON, Arthur
MINING ENGINEER
Placer Mining and Magnetometric Determina-
tions of Mineral Concentrations in the field
300 Haight St., San Francisco, Cal.

GRANT, Wilbur H.
GEOLOGIC AND MINING ENGINEER
1213 Hobart Bdg., 582 Market St.,
San Francisco
Code: Bedford McNeill

David X. Greenberg Frank A. Humphrey
GREENBERG & HUMPHREY
EFFICIENCY ENGINEERS
Kingman, Arizona
Mine Reports and Examinations

GREENOUGH, W. Earl
CONSULTING MINING ENGINEER
Old National Bank Bdg., Spokane, Wash.

HAGER, Dorsey
PETROLEUM GEOLOGIST AND ENGINEER
425 Pacific Finance Bdg., Los Angeles, Cal.

HALL, R. G.
MINING AND METALLURGICAL ENGR.
Complex Ores
Address and Cable: Nantun, Burma
Codes: Broomhall's, A. B. C., McNeills

HAMILTON, E. M.
METALLURGIST
Specialty: Cyaniding Gold and Silver Ores
419 The Embarcadero, San Francisco

HANSON, Henry
METALLURGICAL ENGINEER
Societal Gold and Silver Ores
Plant Design and Construction
Hercules, San Francisco, Cal.

HAWKHURST, Robert, Jr.
MINING ENGINEER
244 H. Cook Building
58 Sutter St., San Francisco, Cal.
Cable: Hawkhurst

HERSEY CO., Milton, Ltd.
CONSULTING MINING ENGINEERS
Montreal and Winnipeg,
Canada

Burch, Hershey & White
HERSHEY, Oscar H.
CONSULTING MINING GEOLOGIST
Crocker Bldg., San Francisco
Cable: Hershey Code: McNeill

HILLS, Victor G.
MINING ENGINEER
312 McPhee Bldg., Denver, Colo.

HODGE, Edwin T.
Consulting Geological and Mining Engineer
Standard Bank Building, Vancouver, B. C.
Department of Geology, University of Oregon,
Eugene, Oregon

HOFFMANN, John D.
MINING ENGINEER
1, London Wall Buildings, London, E.C.2
Usual Codes

HOFFMANN, Karl F.
MINING ENGINEER
Cable: Manhoff 2 Rector St., New York

HOFFMANN, Ross B.
MINING ENGINEER
228 Perry St., Oakland, Cal.
Cable: Siberhof

HOLLIS, H. L.
CONSULTING MINING ENGINEER
AND METALLURGIST
1025 Peoples Gas Bldg., Chicago

HOOVER, Theodore J.
MINING ENGINEER
1, London Wall Bldg., London, E.C.
Mills Bldg., San Francisco
Cable: Madalco

HOSKIN, Arthur J.
CONSULTING ENGINEER
Mining, Metallurgy, Geology, Oil Shale
Technology
1215 York St., Denver, Colo.

HOWIE, A. S.
MINING ENGINEER
Casilla No. 1597 Lima, Peru
Telegrams and Cables: Howie, Lima
Bentley's Code

HOYLE, Charles
MINING ENGINEER
Apartado S. El Oro, Mexico

L. D. Huntoon G. D. Van Arsdale
HUNTOON & VAN ARSDALE
MINING AND CHEMICAL ENGINEERS
115 Broadway, New York Los Angeles, Cal.

HUSTON, H. L.
MINING ENGINEER
485 California St., San Francisco
Cable: Haruston

HITCHINS, John Power
CONSULTING MINING ENGINEER
Room 3700, 120 Broadway,
New York

Budley J. Inskipp John A. Bevan
INSKIPP & BEVAN
MINING ENGINEERS
1 Broad St. Place, London, E.C.
Cable: Metazite Usual Codes

JANIN, Charles
MINING ENGINEER
716 Kohl Bldg., San Francisco
Cable: Charjan Code: McNeill

JENKS, Arthur W.
MINING ENGINEER AND METALLURGIST
2601 Hillegass Ave., Berkeley, Cal.

JULIAN, E. A.
MINING ENGINEER
Goldfield Consolidated Mines Exploration Co.
Crocker Bldg., San Francisco, Cal.

KEENE, Amor F.
CONSULTING MINING ENGINEER
233 Broadway, New York
Cable: Kamor, New York

E. H. Kennard E. C. Bierce
KENNARD & BIERCE
MINING AND METALLURGICAL ENGRS.
Mill Design and Construction, Filtration
Hollingsworth Bldg., Los Angeles, Cal.

KINZIE, Robert A.
MINING ENGINEER
First National Bank Bldg., San Francisco

KIRBY, Edmund B.
MINING ENGINEER AND METALLURGIST
918 Security Bldg., St. Louis
Specialty: The expert examination of mines
and metallurgical enterprises

KRUMB, Henry
MINING ENGINEER
Felt Bldg., Salt Lake City, Utah

LAKENAN, C. B.
MINING ENGINEER
Ely, Nevada

LEHMANN, Charles
MINING ENGINEER
Examination and Management of Properties
Casilla 1364, Santiago, Chile, S. A.

LEVENSALE, L. A.
MINING ENGINEER
Hoge Bldg., Seattle, Wash.

LEWIS, H. Allman
MINING ENGINEER
Cochabamba, Bolivia
Code: McNeill 1908

LINDLEY, Curtis, Jr.
MINING ENGINEERING
604 Mills Bldg., San Francisco, Cal.

LLOYD, R. L.
METALLURGICAL ENGINEER
Specialty: Pyro-Metallurgy of Copper and As-
sociated Metals. 29 Broadway, New York
Cable: Ricloy Code: McNeill

LOCKE, Augustus
MINING GEOLOGIST
788 Mills Bldg., San Francisco, Cal.

Bewick, Moreing & Co.
LORING, E. A.
MINING ENGINEER
62 London Wall, London, E.C. 2
Cable: Ringlo Usual Codes

LORING, Frank C.
MINING ENGINEER
Sun Life Bldg., Toronto, Ontario, Canada

LORING, W. J. MINING ENGINEER
614 Crocker Bldg., San Francisco, Cal.
London Address: C. Bewick, Moreing & Co.,
62, London Wall, London
Cable: Wantoness Usual Codes

LUCKE, P. K.
CONSULTING MINING ENGINEER
Avenida Isabela La Catolica, Num. 25,
Mexico City
Cable: Lucke, Mexico City

LONGYEAR COMPANY, E. J.
EXPLORING ENGINEERS AND GEOLOGISTS
Diamond Drilling and Shaft Sinking
Contractors
Manufacturers of Diamond Drills and Supplies
General Office: 710-722 Security Bldg.,
Minneapolis, Minn.
Cable: Longeo Code: McNeill

LUNT, Horace F.
Commissioner of Mines for Colorado
Denver, Colo.
No professional work undertaken

MAJOR, Chas. Edward
MINING ENGINEER
P.O. Box 474, Prescott, Arizona

MARSHALL, N. C.
MINING ENGINEER
Buenaventura, Colombia,
South America

MATHEWSON, E. P.
CONSULTING ENGINEER
Non-Ferrous Metallurgy
42 Broadway, New York

MAYREIS, L. J.
MINING ENGINEER AND METALLURGIST
% Burma Mines, Ltd.,
Jamshedpur, India

McCARTHY, E. T.
MINING ENGINEER
10 Austin Friars, London

McDERMOTT, E. D.
MINING ENGINEER
Rakka Mines P. O. District, Singhbhum,
Chota Nagpur, India

McGREGOR, A. G.
ENGINEER
Design of Metallurgical Plants
Warren, Arizona

MEIN, William Wallace
MINING ENGINEER
43 Exchange Place, New York
Cable: Mein, New York

MERCER, John W.
MINING ENGINEER
General Manager South American Mines Co.,
Mills Bdg., Broad St., New York

MERRILL COMPANY, THE
Charles W. Merrill, Pres.
Merrill Zinc Dust Precipitation Process
Crowe Vacuum Precipitation Process
San Francisco, Cal.

MILLS, Edwin W.
MINING ENGINEER
24 East Tsung Pu Hutung, Peking, China
Telegrams: Edmills Usual Codes

MINARD, Frederick H.
MINING ENGINEER
47 East 42nd St., New York City
Cable: Frednard Code: McNeill

MITKE, Chas. A.
CONSULTING MINING ENGINEER
Mine Ventilation—Mining Methods
Bisbee, Arizona

MORRIS, F. L.
MINING ENGINEER
1057 Monadnock Bdg., San Francisco
Cable: Fredmor Code: McNeill

MUDD, Seeley W.
MINING ENGINEER
1208 Hollingsworth Bdg., Los Angeles, Cal.

MUIR, N. M.
MINING AND PETROLEUM ENGINEER
1024 Mills Bdg., San Francisco
425 Flynn Ames Bdg., Muskogee, Oklahoma

MUNRO, C. H.
MINING ENGINEER
Ipoh, Perak, Federated Malay States
Cable: Munro Code: McNeill

NEILL, James W.
METALLURGIST AND MINING ENGINEER
604 Mission St., San Francisco, Cal.
Pasadena, Cal. Salt Lake City, Utah

NEWBERRY, Andrew W.
MINING ENGINEER
Room 330, No. 2 Rector St., New York City
Cable: Awnbry, New York Code: Bedford McNeill

NEWMAN, M. A.
MINING ENGINEER
Union League Club, San Francisco, Cal

NOWLAND, Ralph C.
Hobart Bdg., San Francisco
In charge Exploration Dept. of D. C. Jacking

PAYNE, Henry M.
CONSULTING MINING ENGINEER
Machinery Club, 50 Church St., New York
Cable: Macepayne Usual Codes

PERKINS, Walter G.
METALLURGICAL ENGINEER
587 Mills Bdg., San Francisco

PERRET, Leon A.
CONSULTING MINING ENGINEER
Platinum and Gold Placer Mining
30 years practical work in Siberia
5 Bluff Yokohama, Japan

PICKERING, J. C.
CONSULTING MINING ENGINEER
Avenida Juarez 83, Mexico City, Mexico
Cable: Keringpic

PLATE, H. Robinson
MINING ENGINEER
Examination, Development and Management
Hobart Bdg., San Francisco, Cal.

Howard Poillon C. H. Poirier
POILLON & POIRIER
MINING ENGINEERS
42 Broadway, New York

POMMERANTZ, K.
CONSULTING MINING ENGINEER
Casilla 489, Santiago de Chile
Cable: Kivapo, Santiago, Chile Code: McNeill

PRICHARD, W. A.
MINING ENGINEER
Colombian Corporation, Limited,
Apartado 172, Medellin, Colombia

PROBERT, Frank H.
MINING ENGINEER
University of California, Berkeley, Cal.

PURINGTON, C. W.
MINING ENGINEER
5 Sodonsky Pereulok, Vladivostok
6, Copthall Ave., London, E.C., 2

RAY, James C.
MINING ENGINEER AND GEOLOGIST
865 Hamilton Ave.,
Palo Alto, Cal.

RICE, John A.
MINING GEOLOGIST
414 Hobart Bdg., San Francisco

Robert H. Richards Charles E. Locke
RICHARDS & LOCKE
MINING ENGINEERS—ORE TESTING
Tests for design of Flow Sheets
69 Massachusetts Ave., Cambridge, Mass.

RICKARD, Edgar
MINING ENGINEER
42 Broadway, New York

RICKARD, Forbes
MINING ENGINEER
Equitable Building, Denver

RICKETTS, L. D.
CONSULTING ENGINEER
42 Broadway, New York

RITTER, A. Etienne
MINING ENGINEER AND GEOLOGIST
Colorado Springs, Colo.

ROBERTS, Milnor
MINING ENGINEER
The Pacific Northwest
British Columbia and Alaska
University Station, Seattle, Wash.

ROBERTSON, Jasper T.
MINING ENGINEER
1108 Hobart Bdg., San Francisco
Code: McNeill

ROGERS, Edwin M.
CONSULTING MINING ENGINEER
32 Broadway, New York
Cable: Emrog Code: McNeill

ROGERS, John C.
MINING ENGINEER
Examination and Exploration of Mining Prop-
erties with a view to Purchase
Copper Cliff, Ontario Code: Bedford McNeill

Alleo H. Rogers Lucius W. Mayer
Sydney H. Ball

ROGERS, MAYER & BALL
MINING ENGINEERS
42 Broadway, New York
201 Devonshire St., Boston, Mass.
Cable: Alhasters

ROYER, Frank W.
MINING ENGINEER
1212 Hollingsworth Bdg., Los Angeles, Cal.
Cable: Royo Code: McNeill

RUTHERFORD, Forest
Consulting Metallurgist. Ore Smelting Con-
tracts Investigated. Smelting and Milling of
Copper and Lead Ores. Design and Construc-
tion. 120 Broadway, New York

SANDERS, A. D.
MINING ENGINEER
Reports, Consultation and Management. Spe-
cialty, Manganese. Stow Bedon, Norfolk, Eng.
Codes: A. B. C., 5th Ed.; Bedford McNeill

SAUNDERS, T. Skewes
MINING ENGINEER
University Club, Bucareli 35,
Mexico City, Mexico

SEARS, Stanley C.
MINING ENGINEER
Reports, Consultation and Management
705 Walker Bank Bdg., Salt Lake City, Utah
Usual Codes

SHALER, Millard K.
MINING GEOLOGIST AND ENGINEER
66 Rue de Colonies,
Brussels, Belgium

SHEAFE, H. J.
MINING ENGINEER
Mine Examinations and Management
Saratoga, Cal.

SIMPSON, W. E.
MINING ENGINEER
Amos, Quebec, Canada
Fundicion de Los Arcos, Toluca, Mex
P. O. Box 160, Cobalt, Ontario

SIZER, F. L.
CONSULTING MINING ENGINEER
1006 Hobart Bdg., San Francisco

SMITH, Howard D.
MINING ENGINEER
60 Broadway, New York
Cable: Diorite Code: Western Union

Franklin W. Smith Ralph A. Ziesemer
SMITH & ZIESEMER
MINING ENGINEERS
Bisbee, Ariz Code: McNeill

SPILSBURY, P. Gybbon
MINING ENGINEER
214 O'Neill Bdg., Phoenix, Ariz.

STEBBINS, Elwyn W.
MINING ENGINEER
814 Mills Bldg., San Francisco

TURNER, J. K.
MINING ENGINEER
Goldfield, Nevada

WILEY, W. H.
MINING ENGINEER
Palm Drive, Glendora, Cal.

STEVENS, Arthur W.
MINING ENGINEER
Atlanta, Idaho

TURNER, Scott
1511 Bank of Hamilton Bldg.,
Toronto, Ontario, Canada

J. H. Devereux W. B. Devereux, Jr.
WILKENS and DEVEREUX
CONSULTING MINING ENGINEERS
120 Broadway, N. Y. 7, Victoria Ave., London
Cable: Kenreux Code: Bedford McNeill

STEVENS, Blaney
CONSULTING MINING ENGINEER
Tijuana, Baja California, Mexico
C. S. A. de Minas y Montes

TYRRELL, J. B.
MINING ENGINEER AND GEOLOGIST
534 Confederation Life Bldg., Toronto, Canada
208 Salisbury House, London, E. C., 2, England

WINWOOD, Job H.
MINING ENGINEER
Continental Bank Bldg., Salt Lake City, Utah

STEWART, R. H.
MINING AND METALLURGICAL ENGINEER
Vancouver Block, Vancouver, B. C.

WARRINER, R. C.
CONSULTING MINING ENGINEER
42 Exchange Place, New York

WISEMAN, Philip
MINING ENGINEER
1210 Hollingsworth Bldg., Los Angeles
Cable: Filwiseman Codes: W. U.; McNeill

STINES, Norman C.
MINING ENGINEER
4, Moorgate Street, London, E. C., 2
Codes: McNeill (both Editions) and Bentley's
Cable: Narmstine, London

WEATHERBE, D'Arcy
MINING ENGINEER
14 Copthall Ave., London, E. C., 2
And Peking, China
Cable: Nathekoo, London

WISHON, W. W.
MINING ENGINEER
Examination and Exploration of Mining Prop-
erties with View to Financing
Searchlight, Nevada

STORM, L. W.
CONSULTING MINING ENGINEER
MINING GEOLOGIST
1313 Alaska Bldg., Seattle, Wash.

WEBBER, Morton
MINE VALUATION AND DEVELOPMENT
165 Broadway, New York

WOLF, Harry J.
MINING ENGINEER
42 Broadway, New York
Cable: Minewolf Code: Bedford McNeill

STRAUSS, Lester W.
ENGINEER OF MINES
Casilla 514, Valparaiso, Chile, S. A.
Cable: Lestra-Valparaiso Code: McNeill

WEEKES, Frederic R.
MINING ENGINEER
233 Broadway, New York

WRIGHT, Charles Will
MINING ENGINEER
28, Via Parlamento, Rome, Italy
Code: Bentley's

SUMMERHAYES, Maurice W.
MINING ENGINEER
1001 Hobart Bldg., San Francisco

WEIGALL, Arthur R.
MINING ENGINEER
General Manager The Seoul Mining Co.
Tul Mi Chung (Nantei)
Whang Hai Province, Chosen (Korea)

WRIGHT, Louis A.
MINING ENGINEER
370 Langegasse, Obermais, Merano (Trentino),
Italy. Cable: Lawright, Rome
Codes: Bed. McN. & Bentley's Complete Phrase

Arthur F. Taggart B. B. Yerxa
TAGGART & YERXA
CONSULTING ENGINEERS
Operation and design of ore treatment plants
Laboratory, 165 Division St., New Haven, Conn.

WESTERVELT, William Young
CONSULTING MINING ENGINEER
522 Fifth Ave., New York
Cable: Casewest Code: Broomhall's

WROTH, James S.
MINING ENGINEER
Room 827, 2 Rector St., New York

TALMAGE, Sterling B.
MINING GEOLOGIST AND ENGINEER
Geologic Maps, Examinations, Reports
315 Judge Bldg., Salt Lake City, Utah

WHITE, Charles H.
CONSULTING GEOLOGIST
788 Mills Bldg., San Francisco

Pope Yeatman Edwin S. Berry
YEATMAN & BERRY
CONSULTING MINING ENGINEERS
Examination, Development and Management
of Properties
Room 1604, 165 Broadway, New York
Cable: Ikona Code: Bedford McNeill

TAYLOR, G. Cleveland
MINING ENGINEER
U. S. Mineral Surveyor
Prop. Redding Assay Office
321 Butte St., Redding, Cal.

WHITE, J. E.
CONSULTING ENGINEER
Bothin Bldg., Santa Barbara, California

TAYS, Eugene A. H.
CONSULTING MINING ENGINEER
San Blas, Sinaloa, Mexico
Specialties: Professional Work in Mexico;
Mexican Mining Law

Burch, Hershey & White
WHITE, Lloyd C.
CONSULTING ENGINEER
Crocker Bldg., San Francisco

YOUNG, E. J.
CONSULTING GEOLOGIST AND ENGINEER
—
Offices and Laboratory
Story Bldg., Los Angeles, California, U. S. A.
—
Examinations and Reports on all Mineral
Deposits, Formations and Processes
of Extraction
—
20 years experience in the Western States,
Pacific Coast States, U. S. A., Mexico
and Central America

THORNE, W. E.
MINING ENGINEER
S. Old Jewry, London, E. C., 2
Codes: McNeill, both Editions

WHITMAN, Alfred R.
MINING GEOLOGIST
Underground Programmes, Orebody Problems
43 Exchange Place, New York
Haleybury, Ontario (Cobalt District)

TITCOMB, H. A.
MINING ENGINEER
% A Chester Beatty, 25 Broad St., New York
Code: Bedford McNeill

WHITMORE, Claude C.
CONSULTING MINING ENGINEER AND
METALLURGIST
3216 Bayard St., Butte, Montana

TURNER, H. W.
MINING GEOLOGIST
Mills Bldg., San Francisco
Cable: Latite Cable: Bedford McNeill

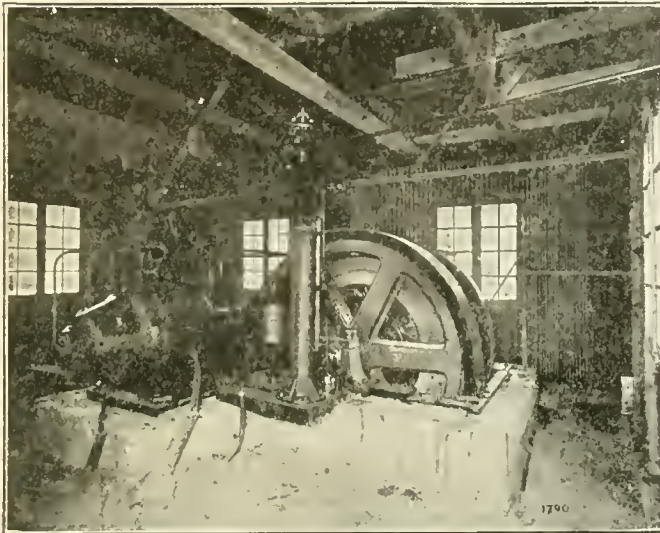
WICKS, Frank R.
CONSULTING ENGINEER
Ore Treatment, Test Work, Plant Supervision
Office and Laboratory: 1006 South Hill St.,
Los Angeles

ZEIGLER, Victor
GEOLOGICAL ENGINEER
Examination of oil lands and mineral deposits
Geologic and structural maps
415 Empire Bldg., Denver, Colo.

LIDGERWOOD MINE HOISTS

ELECTRIC IN ANY SIZE

STEAM UP TO 1000 H.P.



It is in the Mine that the Value of the Hoist is Determined.

The hoist must have speed to give daily capacity.

It must have strength to handle your output every day in the year.

These facts govern every step in the design and construction of the Lidgerwood Hoist.

Our engineers will gladly consult with you regarding your requirements.

SEND FOR CATALOGUE

LIDGERWOOD MFG. CO.

96 Liberty Street, New York

Pittsburg
Cleveland

Los Angeles

Philadelphia

Seattle

Chicago
London, Eng.

MITCHELL ELECTRIC VIBRATING SCREEN

The big advance in the development of screening devices, achieved by the Mitchell, is the application of power from beneath the screen at a high frequency of vibration and with a powerful impact. Continuous operation under the most arduous conditions is daily proving the correctness of Mitchell construction.

WRITE US FOR COMPLETE DETAILS

STIMPSON EQUIPMENT COMPANY

MANUFACTURERS AND SOLE AGENTS

Felt Bldg.

Salt Lake City, Utah

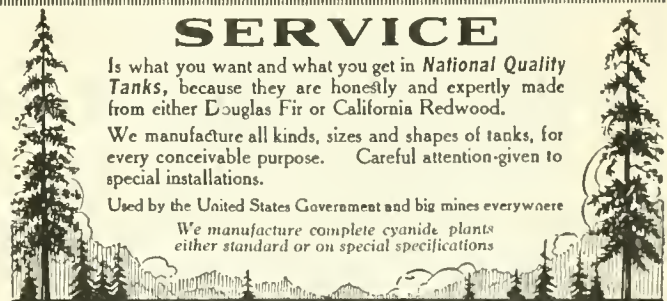
SERVICE

Is what you want and what you get in *National Quality Tanks*, because they are honestly and expertly made from either Douglas Fir or California Redwood.

We manufacture all kinds, sizes and shapes of tanks, for every conceivable purpose. Careful attention given to special installations.

Used by the United States Government and big mines everywhere

We manufacture complete cyanide plants either standard or on special specifications



NATIONAL TANK & PIPE CO.

KENTON STATION

PORTLAND, ORE

Laboratory Supplies
Fire Clay Products



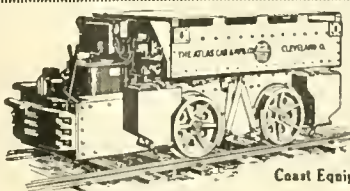
Oil Burners
Metallurgical Furnaces

THE DENVER FIRE CLAY COMPANY

Denver, Colorado, U. S. A.

New York Office: 50 E. 41st St.

Utah Dept., Salt Lake City



LOCOMOTIVES — CARS

Switches, Frogs and Equipment
FOR MINES, SMELTERS, ETC.

The Atlas Car & Manuf. Co.
CLEVELAND, OHIO

Coast Equipment Co., 766 Folsom St., San Francisco
and San Fernando Bldg., Los Angeles

The DORR COMPANY, Engineers

New York Denver London Mexico City

Equipment for the mechanical washing, removal, recovery, classification or treatment of finely divided solids suspended in liquids.

HERRINGBONE CUT GEARS

MILL
DRIVES

FAWCUS

SPEED REDUCERS

SPUR
WORM
BEVEL GEARS

FAWCUS MACHINE CO. PITTSBURGH, PA.

ASSAYERS, CHEMISTS AND ORE-TESTING WORKS

ARIZONA ASSAY OFFICE

(F. W. Libbey)
Assayers, Chemists and Metallurgists
CONTROL AND UMPIRE WORK
303-307 N. First St., Phoenix, Arizona

ATKIN & McRAE

Assayers, Chemists and Metallurgists
CONTROL AND UMPIRE ASSAYS
Flotation and Cyanide Tests
1008 South Hill St., Los Angeles, Cal.

BARDWELL, Alonzo F.

CUSTOM ASSAYER AND CHEMIST
(Successor to Bettles & Bardwell)
158 S. W. Temple St., Salt Lake City, Utah
Ore Shippers' Agent

BAVERSTOCK & PAYNE

INDUSTRIAL CHEMISTS AND ASSAYERS
Technical and Chemical Analysis of Ores
Minerals, and All Organic Materials
233 W. First St., Los Angeles, Cal.

BECKMAN & LINDEN ENG. CORP.

Chemical, electro-chemical, metallurgical and
electro-metallurgical investigations and
reports Processes developed
804 Atlas Bldg., San Francisco

COLE & CO.

ASSAYERS, CHEMISTS, ORE BUYERS
Shippers' Representatives
Box BB, Douglas, Arizona

CRITCHETT & FERGUSON

ASSAYERS AND CHEMISTS
El Paso, Texas
Umpire and Controls a Specialty

DWIGHT & LLOYD SINTERING CO.

Special problems in ore treatment
29 Broadway, New York City
Cable Address: Sinterer

FROST, Oscar J.

ASSAYER AND CHEMIST
1310-12 15th Ave.,
P. O. Box 145, Denver, Colo.

GIBSON, Walter L.

Successor to
FALKENAU ASSAYING CO.
ASSAY OFFICE AND ANALYTICAL
LABORATORY, SCHOOL OF ASSAYING
824 Washington St. Oakland, Cal.
Phone 8929

Umpire assays and supervision of sampling.
Working tests of ores, analysis. Investiga-
tions of metallurgical and technical processes.
Professor L. Falkenau, General Manager and
Consulting Specialist

IRVING & CO., James

ASSAYERS AND GOLD BUYERS
Mines Examined
702 South Spring St., Los Angeles, Cal.

OFFICER & CO., R. H.

ASSAYERS AND CHEMISTS
Oils, Hydrocarbons and Oil Shale Analysis
169 South West Temple Street,
Salt Lake City, Utah

GENERAL ENGINEERING CO., THE

CONSULTING ENGINEERS

159 Pierpont Avenue, Salt Lake City, Utah

Design and Erection of all Classes of Reduction Plants

ORES TESTED IN SMALL OR 10-TON LOTS BY AMALGAMATION, CONCENTRATION,
CYANIDATION, MAGNETIC SEPARATION, FLOTATION

The 4th edition of our Ore Testing Bulletin is now ready for mailing. We shall be pleased to
send it to you upon request

New York Office, 120 Broadway, Room 3022. C. E. Chaffin, Local Manager

Australian Agent: F. H. Jackson, 22 Carrington St., Wynward Square, Sydney, N. S. W., Australia

J. M. CALLOW, President

HAMILTON, BEAUCHAMP, WOODWORTH, Inc.

METALLURGICAL ENGINEERS

SPECIALTY: THE TREATMENT OF GOLD AND SILVER ORES, BY FLOTATION, BY
CYANIDE, OR BY A COMBINATION OF BOTH PROCESSES

Flotation of Copper, Lead, Zinc, and Other Minerals

Tests made on Lots of 1 lb. up to 5 Tons

MILLS DESIGNED AND CONSTRUCTED, CONSULTING AND EXPERT WORK UNDERTAKEN
Laboratory and Office, 419 The Embarcadero, San Francisco

Telephone: Sutter 5268

Cable address: Hambeau

Code: West. Union; Red. McNeill

LEDoux & CO., Inc.

ASSAYERS, CHEMISTS AND METALLURGISTS

Independent samplers at the port of New York

Representatives at all Refineries and Smelters on Atlantic Seaboard

Office and Laboratory: 99 John Street, New York

C. A. LUCKHARDT CO.

Telephone, Kearny 5951

A. H. WARD

ASSAYERS AND CHEMISTS

Sampling or Ores at Smelters

53 Stevenson St., San Francisco

SMITH, EMERY & CO.

(Ore Testing Plant, Los Angeles)

INDEPENDENT CONTROLS AND UMPIRE ASSAYERS

Represent Shippers at Smelters, Test Ores, and Design Mills

651 Howard Street, San Francisco

245 South Los Angeles Street, Los Angeles

NEW MEXICO STATE SCHOOL OF MINES

An Institution of Technology and Engineering. Full degrees, low cost, fine climate, new
equipment, accessible to mines and smelters. Write for catalogue.

A. X. ILLINISKI, President, Socorro, New Mexico

HANKS, Abbott A.

CHEMIST AND ASSAYER

Established 1866

624 Sacramento St., San Francisco

Control and Umpire Assays, Supervision of
Sampling at Smelters

Bureau of Inspection and Testing

RICHARDS & SOX, J. W.

ASSAYERS AND CHEMISTS
1118 Nineteenth St., Denver
Ore Shippers' Agent. Write for terms
Representatives at all Colorado smelters

PITKIN, Inc., Lucius

Weighers, Samplers and Assayers of Ores of
all Descriptions
47 Fulton St., New York
Cable: Niktip

INDUSTRIAL RESEARCH COMPANY

Successors to
Geo. A. James Co.

INDUSTRIAL CHEMISTS AND ENGINEERS
ASSAYERS, CHEMISTS

We Specialize on Chemical and Metallurgical
Troubles

Laboratory: 28 Belden Place, San Francisco

THE TWINING LABORATORIES

ASSAYERS AND CHEMICAL
ENGINEERS
Fresno, Cal.

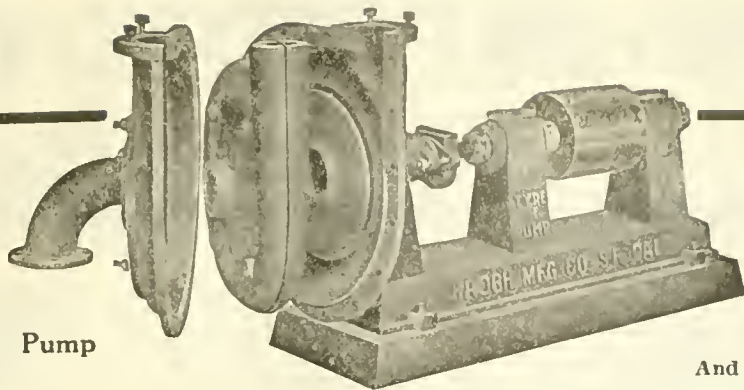
THE BOOK DEPARTMENT

of the Mining and Scientific Press
carries a complete line of Tech-
nic 1 Books on all subjects allied
to the mining field.

PEREZ CO., R. A.

ASSAYERS, CHEMISTS, AND
METALLURGISTS
(Established 1895)
120 N. Main St., Los Angeles, Cal.

KROGH



PUMPS

Some Krogh Lined Pump Users:

Anaconda Copper Mining Co.
 Arizona Copper Co.
 Braden Copper Co.
 Cerro de Pasco Copper Corporation.
 Cobalt Lake Mining Co.
 East Butte Copper Mining Co.
 Engels Copper Mining Co.
 Federal Mining & Smelting Co.
 Inspiration Cons. Copper Co.
 Miami Copper Co.
 Premier Gold Mining Co.
 Seoul Mining Co.
 Shattuck Arizona Copper Co.
 Trail Smelter.
 U. S. Smelting & Refining Co.

The **KROGH SAND AND TAILINGS PUMP** has ended the pump troubles of many of the largest mining companies in the world. It will do the same for you.

And here are a few of its features:

Made of a special chilled iron, extremely hard.

Entirely lined inside, being practically one pump inside an outer shell.

All bearings contain movable bushings. Drive bearings are of ring-oil type.

Casings and suction elbows can be moved around shaft, eliminating elbows.

Shafts of turned steel and extra heavy.

Every wearing part easily and quickly renewable.

WRITE FOR BULLETIN M-79



KROGH PUMP AND MACHINERY CO.

149 BEALE STREET

SAN FRANCISCO, CAL.

American Wire Rope
 AND
AERIAL WIRE TRAMWAYS
 Send for Illustrated Catalogue
American Steel & Wire Company
 Chicago-New York

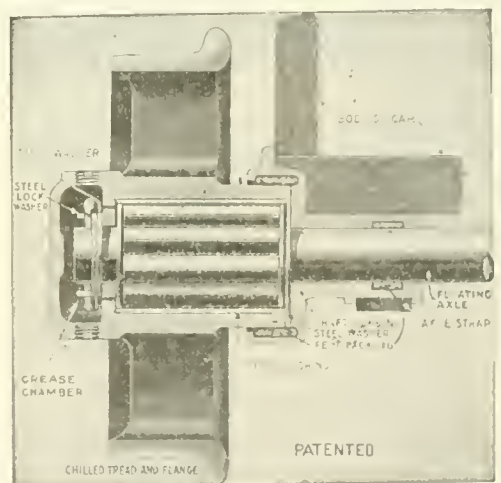
FARREL & BACON
 ORE & ROCK
CRUSHERS & ROLLS
 EARLE C. BACON, INC. ENGINEERS
 26 CORTLAND ST. NEW YORK. SEND FOR BULLETIN C-1

YUBA
 GOLD DREDGES

Yuba Ball Tread Tractors Yuba Centrifugal Pumps

YUBA MANUFACTURING COMPANY

WORKS: Marysville, Cal. SALES OFFICE: 433 California St., San Francisco, Cal.



Longer Service -- Lower Upkeep

Ottumwa Patent
ROLLER BEARING WHEELS

They will require greasing only once or twice a year and but 50% of the drawbar pull required to move cars equipped with the ordinary self-oiling wheels.

Write for quotation

OTTUMWA IRON WORKS - Ottumwa, Iowa.

THE - BUYER'S - GUIDE

Machinery and Supplies of Dependable Manufacturers are here Listed
Addresses will be found on the Sixth following Page ...
If you do not find what you want communicate with MINING and SCIENTIFIC PRESS SERVICE

Acetylene Generators

Bullard, E. D.

Aftercoolers, Air

Chicago Pneumatic Tool Co.

Agitators

Chalmers & Williams
Dorr Co.
Meese & Gottfried Co.
National Tank & Pipe Co.
Pacific Tank & Pipe Co.
Trent, Goodwin M.

Air Pipe

W. R. Ames Co.

Air Receivers

Chicago Pneumatic Tool Co.
Ingersoll-Rand Co.
Rix Compressed Air & Drill Co.
Simpson Co., A. H.
Sullivan Machinery Co.

Amalgamating Plates

Denver Engineering Works Co.
Morse Bros. Machy. & Sup. Co.
San Francisco Plating Works
Simpson Co., A. H.
Worthington Pump & Mach. Corp.

Amalgamators

Mine & Smelter Supply Co.

Assayers' and Chemists' Supplies

Bartley Crucible Co., Jonathan
Braun Corporation
Braun-Knecht-Heimann Co.
Caire Co., Justinian
Calkins Co.
Denver Engineering Works Co.
Denver Fire Clay Co.
Dixon Crucible Co., Joseph
Mine & Smelter Supply Co.
(See Index to Advertisers)

Bags

Braun Corporation
Braun-Knecht-Heimann Co.

Balances and Weights

Braun Corporation
Braun-Knecht-Heimann Co.
Caire Co., Justinian
Calkins Co.
Denver Fire Clay Co.
Fairbanks, Morse & Co.
Meese & Smelter Supply Co.
Morse Bros. Machy. & Sup. Co.
Thompson Balance Co.

Balls for Ball-Mills

Bethlehem Shipbuilding Corp., Ltd.
Chalmers & Williams
Denver Engineering Works Co.
Hardinge Co.
Hickok & Hickok
Los Angeles Foundry Co.

Ball-Mills (see 'Mills')

Bells

Garratt & Co., W. T.

Belting and Lacing

Diamond Rubber Co., Inc.
Dodge Sales & Engineering Co.
Fairbanks, Morse & Co.
Flexible Steel Lacing Co.
Goodrich Rubber Co., B. F.
Main Belting Co.
Meese & Gottfried Co.
New York Belting & Packing Co.
Pioneer Rubber Mills
U. S. Rubber Co.

Blowers

Allis-Chalmers Mfg. Co.
General Electric Co.
Ingersoll-Rand Co.
Mine & Smelter Supply Co.
Morse Bros. Machy. & Sup. Co.
Nordberg Mfg. Co.
Rix Compressed Air & Drill Co.

Blowing Engines

Nordberg Mfg. Co.

Boilers

Bethlehem Shipbuilding Corp., Ltd.
Mine & Smelter Supply Co.
Morse Bros. Machy. & Sup. Co.

Books, Technical

Mining and Scientific Press

Brick, Fire

Atkins, Kroll & Co.
Denver Fire Clay Co.
Harrison-Walker Refractories Co.
Mine & Smelter Supply Co.

Briquetting Machinery

Traylor Eng. & Mfg. Co.

Buckets

Atlas Car & Mfg. Co.
Box Iron Works Co., Wm. A.
Meese & Gottfried Co.
Mine & Smelter Supply Co.
Simpson Co., A. H.

Burners, Oil

Braun Corporation
Braun-Knecht-Heimann Co.
Denver Fire Clay Co.
Lunkenheimer Co.
Mine & Smelter Supply Co.
Powell Co., Wm.

Cages

Atlas Car & Mfg. Co.
Mine & Smelter Supply Co.
Morse Bros. Machy. & Sup. Co.
Traylor Eng. & Mfg. Co.

Calculating Machines

Monroe Calculating Machine Co.

Carbide Flame Lights

Bullard, E. D.

Carbans, Borts, and Diamonds

Atkins, Kroll & Co.

Cars

Allis-Chalmers Mfg. Co.
Atlas Car & Mfg. Co.
Box Iron Works Co., Wm. A.
Chicago Pneumatic Tool Co.
Mine & Smelter Supply Co.
Ottumwa Iron Works
Simpson Co., A. H.
Western Wheeled Scraper Co.

Chain

Dodge Sales & Engineering Co.
Meese & Gottfried Co.

Chemicals

Barrett Co.
Braun Corporation
Braun-Knecht-Heimann Co.
Caire Co., Justinian
Calkins Co.
Denver Fire Clay Co.
Du Pont de Nemours & Co.
Hercules Powder Co.
Mine & Smelter Supply Co.
Roessler & Hasslacher Chem. Co.

Chilean Mills (see 'Mills')

Chisel Blanks

Chicago Pneumatic Tool Co.

Chrome Brick

Harrison-Walker Refractories Co.

Classifiers

Allis-Chalmers Mfg. Co.
Box Iron Works Co., Wm. A.
Chalmers & Williams
Colorado Iron Works
Deister Machine Co.
Denver Engineering Works Co.
Dorr Co.
Meese & Gottfried Co.
Pacific Tank & Pipe Co.
Traylor Eng. & Mfg. Co.

Clutches, Friction (see 'Transmissions Machinery')

Compressors

Allis-Chalmers Mfg. Co.
Cement-Gun Co.
Chalmers & Williams
Chicago Pneumatic Tool Co.
Fairbanks, Morse & Co.
General Electric Co.
Ingersoll-Rand Co.
Jackson Compressor Co.
Mine & Smelter Supply Co.

Morse Bros. Machy. & Sup. Co.
Nordberg Mfg. Co.
Rix Compressed Air & Drill Co.
Simpson Co., A. H.
Sullivan Machinery Co.
Worthington Pump & Mach. Corp.

Compressors, Mine Air

Chicago Pneumatic Tool Co.

Concentrators

Allis-Chalmers Mfg. Co.
Butchart, W. A.
Chalmers & Williams
Colorado Iron Works
Deister Concentrator Co.
Deister Machine Co.
Denver Engineering Works Co.
Elsol Concentrating Co.
James Ore Concentrator Co.
Mine & Smelter Supply Co.
Morse Bros. Machy. & Sup. Co.
Simpson Co., A. H.
Traylor Eng. & Mfg. Co.
Worthington Pump & Mach. Corp.

Concentrators, Dry

Elsol Concentrating Co.

Dump Cars, V-Shaped and Mining

Koppel Industrial Car & Equip. Co.

Condensers, Low Level Jet

Ingersoll-Rand Co.

Condensers, Surface

Ingersoll-Rand Co.

Contractors, Core Drilling

Sullivan Machinery Co.

Converters

Allis-Chalmers Mfg. Co.
Traylor Eng. & Mfg. Co.
Worthington Pump & Mach. Corp.

Conveyors, Belt or Screw

Allis-Chalmers Mfg. Co.
Goodrich Rubber Co., B. F.
Main Belting Co.
Meese & Gottfried Co.
New York Belting & Packing Co.
Pioneer Rubber Mills
Worthington Pump & Mach. Corp.
U. S. Rubber Co.

Couplings, Air Hose

Chicago Pneumatic Tool Co.

Cranes

Box Iron Works Co., Wm. A.
Chicago Pneumatic Tool Co.

Crucibles

Bartley Crucible Co., Jonathan
Braun Corporation
Braun-Knecht-Heimann Co.
Caire Co., Justinian
Calkins Co.
Denver Fire Clay Co.
Dixon Crucible Co., Joseph
Mine & Smelter Supply Co.

Crushers

Allis-Chalmers Mfg. Co.
Bacon, Inc., Earle C.
Box Iron Works Co., Wm. A.
Braun Corporation
Braun-Knecht-Heimann Co.
Caire Co., Justinian
Calkins Co.
Chalmers & Williams
Colorado Iron Works
Denver Engineering Works Co.
Denver Fire Clay Co.
Elsol Concentrating Co.
Mine & Smelter Supply Co.
Morse Bros. Machy. & Sup. Co.
Simpson Co., A. H.
Traylor Eng. & Mfg. Co.
Worthington Pump & Mach. Corp.

Crushers, Jaw

Buchanan Co., Inc., C. G.

Cupels

Braun Corporation
Braun-Knecht-Heimann Co.
Denver Fire Clay Co.
Dixon Crucible Co., Joseph
Mine & Smelter Supply Co.

Cyanide

American Cyanamid Co.
Roessler & Hasslacher Chem. Co.

Cyanide Plants and Machinery

Aldrich Pump Co.
Allis-Chalmers Mfg. Co.
Colorado Iron Works
Dorr Co.
Mine & Smelter Supply Co.
Morse Bros. Machy. & Sup. Co.
National Tank & Pipe Co.
Oliver Continuous Filter Co.
Pacific Tank & Pipe Co.
Redwood Mfrs. Co.
Traylor Eng. & Mfg. Co.
Trent, Goodwin M.
Worthington Pump & Mach. Corp.

Dewaterers

Chalmers & Williams
Colorado Iron Works
Dorr Co.
General Engineering Co.
Morse Bros. Machy. & Sup. Co.
Oliver Continuous Filter Co.
Ruggles-Coles Eng. Co.
Traylor Eng. & Mfg. Co.

Drafting Materials

Dixon Crucible Co., Joseph

Dragline Excavators

Leachen & Sons Rope Co., A.
Lidgerwood Mfg. Co.

Dredges and Accessories

Bethlehem Shipbuilding Corp., Ltd.
Hickok & Hickok
Leachen & Sons Rope Co., A.
New York Engineering Co.
Union Construction Co.
Yuba Mfg. Co.

Drill Makers and Sharpeners

Denver Rock Drill Mfg. Co.
General Electric Co.
Ingersoll-Rand Co.
Sullivan Machinery Co.

Drills, Air and Steam

Chicago Pneumatic Tool Co.
Cleveland Rock Drill Co.
Cochise Machine Co.
Denver Rock Drill Mfg. Co.
Hendrie & Bolthoff Mfg. & Sup. Co.
Ingersoll-Rand Co.
Mine & Smelter Supply Co.
Rix Compressed Air & Drill Co.
Simpson Co., A. H.
Sullivan Machinery Co.

Drills, Core

Chicago Pneumatic Tool Co.
Dobbins Core Drill Co.
Ingersoll-Rand Co.
Longyear Co., E. J.
New York Engineering Co.
Sullivan Machinery Co.

Drills, Diamond

Ingersoll-Rand Co.
Longyear Co., E. J.
Sullivan Machinery Co.

Dryers

Allis-Chalmers Mfg. Co.
Colorado Iron Works
Fuller-Lehigh Co.
Ruggles-Coles Eng. Co.
Traylor Eng. & Mfg. Co.
Worthington Pump & Mach. Corp.

Dryers, Rotary

Ruggles-Coles Eng. Co.

Electrical Supplies

Allis-Chalmers Mfg. Co.
General Electric Co.
Westinghouse Elec. & Mfg. Co.

Electric Tools, Portable

Chicago Pneumatic Tool Co.

Elevators, Bucket

Buchanan Co., Inc., C. G.

Employment Bureau

Business Men's Clearing House

(Continued of Page 36)

HOSKINS ELECTRIC FURNACES

ADVANTAGES

Can Be Regulated and Controlled Easily and Accurately.
Give Uniform and Constant Temperature.

Are Economical in Operation and Maintenance.

Give Uniform Results.

Are Clean and Convenient.

Save Time.

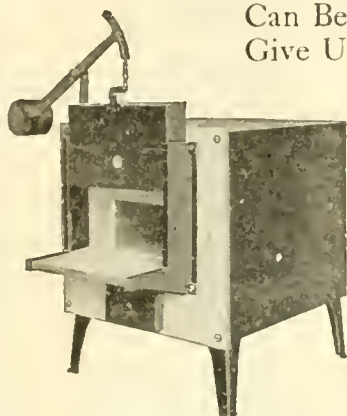
Do Not Require Close Attention.

Are Free from Gases, Smoke and Odor.

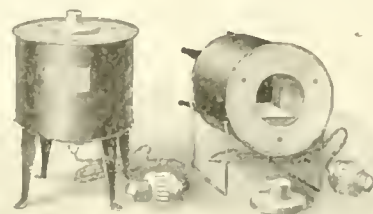
Are Free from Noise and Fire Risk.

Are Always Ready for Immediate Use.

Are Long-lived and Easy to Repair.



TYPE FD MUFFLE



Type FA No. 101—CRUCIBLE FURNACE
Position on right shows use as a muffle furnace.

PYROMETERS

HOT PLATES

RHEOSTATS

CHROMELWIRE AND TRIANGLES

Justinian Caire Company

SAN FRANCISCO, CAL.

Established in 1851 Under the Same Name

The Calkins Company

LOS ANGELES, CAL.

Barrett Standardized Flotation Reagents

You can increase the profits from your ore by using

Barrett Standardized Flotation Reagents

They are uniform and always dependable.

Write us for free booklet containing valuable information on Flotation Oils and Reagents.

The *Barrett* Company

17 Battery Place
New York City



Salt Lake City
Utah

AIR PIPE

GALVANIZED IRON AIR PIPE FOR MINE VENTILATION

Shipped either "Set-Up", or "Knocked-Down" for assembling on the ground. Each joint of pipe 10 feet long and fully guaranteed.

WRITE FOR LATEST PRICES

W. R. AMES & CO. INC. 450 IRWIN ST.
SAN FRANCISCO

MANUFACTURING

"SUNNY SOUTH"

FLOTATION OILS

Six Standard Pure Oils From Pine

FLORIDA WOOD PRODUCTS CO., Jacksonville, Florida

FLOTATION

PURE PINE OIL PINE TAR OIL
HARDWOOD AND COAL TAR CREOSOTE

Write for new Booklet

General Naval Stores Co.,

90 West Street, New York

— PINE — FLOTATION OILS

Pensacola Tar & Turpentine Company

F. E. MARINER, PRES.

GULL POINT, FLA.



Buchanan Magnetic Pulleys
Crushers
Crushing Rolls

C. G. BUCHANAN CO., INC.
WEST AND CEDAR STS., NEW YORK

Western Representative: W. H. Moore Jr., Trustee for Collins & Webb, Inc.
447 East Third Street, Los Angeles

THE BUYER'S GUIDE

Engineers (Designing and Contracting)

Box Iron Works Co., Wm. A.
Stearns-Roger Mfg. Co.

Engines, Internal Combustion

Allis-Chalmers Mfg. Co.
Bosch & Sons Bros.
Chicago Pneumatic Tool Co.
Fairbanks, Morse & Co.
Mine & Smelter Supply Co.
Morse Bros. Machy. & Sup. Co.
Nordberg Mfg. Co.
Westinghouse Pump & Mach. Corp.

Engines, Oil

Chicago Pneumatic Tool Co.
Ingersoll-Rand Co.
Worthington Pump & Mach. Corp.

Engines, Steam

Allis-Chalmers Mfg. Co.
Chicago Pneumatic Tool Co.
Ingersoll-Rand Co.
Morse Bros. Machy. & Sup. Co.
Nordberg Mfg. Co.
Simpson Co., A. H.
Worthington Pump & Mach. Corp.

Explosives

Du Pont Powder Co.
Hercules Powder Co.

Filters

Chalmers & Williams
Colorado Iron Works
Merrill Co.
Morse Bros. Machy. & Sup. Co.
Oxver Continuous Filter Co.
United Filters Corp.
Worthington Pump & Mach. Corp.

Filter Cloth, Metallic

Ludlow-Saylor Wire Co.
Tyler Co., W. S.
United Filters Corp.

Filter Presses

Merrill Co.
Morse Bros. Machy. & Sup. Co.
United Filters Corp.

Fire Extinguishers

Bullard, E. D.

First Aid Equipment

Braun Corporation
Braun-Knecht-Heimann-Co.
Bullard, E. D.

Flotation Apparatus

Braun Corporation
Braun-Knecht-Heimann-Co.
Butchart, W. A.
Denver Engineering Works Co.
Mine & Smelter Supply Co.
National Tank & Pipe Co.
Simpson Co., A. H.

Flow Meters

General Electric Co.

Forges

Denver Fire Clay Co.
Ingersoll-Rand Co.
Mine & Smelter Supply Co.

Frogs and Switches (see 'Railway Supplies')

Forgings

Cambria Steel Co.

Furnaces, Assay (see 'Assayers' and 'Chemists' Supplies')

Furnaces, Oil

Denver Fire Clay Co.
Ingersoll-Rand Co.

Furnaces, Roasting and Smelting

Allis-Chalmers Mfg. Co.
Colorado Iron Works
Denver Engineering Works Co.
Dwight & Lloyd Sintering Co., Inc.
Mine & Smelter Supply Co.
Morse Bros. Machy. & Sup. Co.
Traylor Eng. & Mfg. Co.
Westinghouse Elec. & Mfg. Co.

Gears

American Steel Foundries
Chicago Pneumatic Tool Co.
Denver Engineering Works Co.
Fawcus Machine Co.
General Electric Co.
Meese & Gottfried Co.

Gears, Herringbone

Fawcus Machine Co.

Generators, Electric

Allis-Chalmers Mfg. Co.
General Electric Co.
Morse Bros. Machy. & Sup. Co.
Westinghouse Elec. & Mfg. Co.

Grants, Hydraulic (see 'Hydraulic Mining Machinery')

Graphite Products

Bartley Crucible Co., Jonathan
Dixon Crucible Co., Joseph

Grinders, Laboratory

Braun Corporation
Braun-Knecht-Heimann Co.
Cairn Co., Justinian
Calkins Co.
Denver Engineering Works Co.
Ingersoll-Rand Co.

Grinders, Portable, Air and Electric

Chicago Pneumatic Tool Co.

Grinding Wheels

New York Belting & Packing Co.

Hammers, Pneumatic

Chicago Pneumatic Tool Co.

Heaters, Feed Water

Allis-Chalmers Mfg. Co.
Morse Bros. Machy. & Sup. Co.
Simpson Co., A. H.
Worthington Pump & Mach. Corp.

Holsts, Electric

Allis-Chalmers Mfg. Co.
Box Iron Works Co., Wm. A.
Chicago Pneumatic Tool Co.
Denver Engineering Works Co.
Hendrie & Bolthoff Mfg. & Sup. Co.
Leschen & Sons Rope Co., A.
Lidgerwood Mfg. Co.
Mine & Smelter Supply Co.
Morse Bros. Machy. & Sup. Co.
Nordberg Mfg. Co.
Ottumwa Iron Works
Rix Compressed Air & Drill Co.
Simpson Co., A. H.
Westinghouse Elec. & Mfg. Co.

Holsts, Oil and Distillate

Box Iron Works Co., Wm. A.
Denver Engineering Works Co.
Leschen & Sons Rope Co., A.
Simpson Co., A. H.

Holsts, Steam or Air

Allis-Chalmers Mfg. Co.
Box Iron Works Co., Wm. A.
Chicago Pneumatic Tool Co.
Hendrie & Bolthoff Mfg. & Sup. Co.
Ingersoll-Rand Co.
Leschen & Sons Rope Co., A.
Lidgerwood Mfg. Co.
Mine & Smelter Supply Co.
Morse Bros. Machy. & Sup. Co.
Nordberg Mfg. Co.
Ottumwa Iron Works
Rix Compressed Air & Drill Co.
Simpson Co., A. H.

Hose

Chicago Pneumatic Tool Co.
Cochise Machine Co.
Denver Rock Drill Mfg. Co.
Goodrich Rubber Co., B. F.
Ingersoll-Rand Co.
New York Belting & Packing Co.
Pioneer Rubber Mills
Rix Compressed Air & Drill Co.
Simpson Co., A. H.
U. S. Rubber Co.

Hydraulic Mining Machinery

Aldrich Pump Co.
Allis-Chalmers Mfg. Co.
American Spiral Pipe Works
Garratt & Co., W. T.
New York Engineering Co.
Pelton Water Wheel Co.
Sacramento Pipe Works

Hydrocyanic Acid; Liquid

American Cyanamid Co.

Industrial Railways, Portable

Koppel Industrial Car & Equip. Co.

Injectors

Lunkenheimer Co.
Morse Bros. Machy. & Sup. Co.
Powell Co., Wm.

Iron Cements

Smooth-On Mfg. Co.

Jigs

Allis-Chalmers Mfg. Co.
Box Iron Works Co., Wm. A.
Chalmers & Williams
Colorado Iron Works
Denver Engineering Works Co.
Morse Bros. Machy. & Sup. Co.
New York Engineering Co.
Traylor Eng. & Mfg. Co.
Union Construction Co.
Worthington Pump & Mach. Corp.

Kilns

Allis-Chalmers Mfg. Co.

Laboratory Supplies (see 'Assayers' and 'Chemists' Supplies')

Lamp Guards

Flexible Steel Lacing Co.

Lamps, Arc and Incandescent

General Electric Co.
Westinghouse Elec. & Mfg. Co.

Lamps, Miners'

Bullard, E. D.
Wolf Safety Lamp Co.

Lining for Ball-Mills

Chalmers & Williams
Fuller-Lehigh Co.
Hardinge Co.
Hickok & Hickok
Los Angeles Foundry Co.
Traylor Eng. & Mfg. Co.

Linings for Tube Mills

Fuller-Lehigh Co.

Loading Machines, Pneumatic

Lake Superior Loader Co.

Locomotives, Electric

Atlas Car & Mfg. Co.
General Electric Co.
Morse Bros. Machy. & Sup. Co.
Simpson Co., A. H.
Westinghouse Elec. & Mfg. Co.

Locomotives, Steam

Morse Bros. Machy. & Sup. Co.
Simpson Co., A. H.

Lubricants

Chicago Pneumatic Tool Co.
Dixon Crucible Co., Joseph

Lubricators

Chicago Pneumatic Tool Co.
Lunkenheimer Co., The
Powell Co., Wm.

Machinery, Used

Morse Bros. Machy. & Sup. Co.
Nevada Engineering & Supply Co.
Pacific Pipe Co.
Simpson Co., A. H.

Magnesia Brick

Harbison-Walker Refractories Co.

Metal Buyers and Dealers

American Smelters Securities Co.
American Zinc, Lead & Smelt. Co.
Atkins, Kroll & Co.
International Smelting Co.
U. S. Smelting, Ref. & Min. Co.
Wildberg Bros.

Mills—Ball, Pebble and Tube

Allis-Chalmers Mfg. Co.
Bethlehem Shipbuilding Corp., Ltd.
Box Iron Works Co., Wm. A.
Chalmers & Williams
Colorado Iron Works
Denver Engineering Works Co.
Denver Fire Clay Co.
Hardinge Co.
Mine & Smelter Supply Co.
Morse Bros. Machy. & Sup. Co.
Stearns-Roger Mfg. Co.
Traylor Eng. & Mfg. Co.
Worthington Pump & Mach. Corp.

Mills, Chilean

Allis-Chalmers Mfg. Co.
Chalmers & Williams
Colorado Iron Works
Lane Mill & Machinery Co.
Morse Bros. Machy. & Sup. Co.
Traylor Eng. & Mfg. Co.
Worthington Pump & Mach. Corp.

Mills, Grinding

Fuller-Lehigh Co.
Marathon Mill & Machine Works

Mills, Stamp

Allis-Chalmers Mfg. Co.
Bethlehem Shipbuilding Corp., Ltd.
Chalmers & Williams
Colorado Iron Works
Hendy Iron Works, Joshua
Morse Bros. Machy. & Sup. Co.
Simpson Co., A. H.
Straub Mfg. Co.
Traylor Eng. & Mfg. Co.
Worthington Pump & Mach. Corp.

Motors

Allis-Chalmers Mfg. Co.
Fairbanks, Morse & Co.
General Electric Co.
Hendrie & Bolthoff Mfg. & Sup. Co.
Ingersoll-Rand Co.
Mine & Smelter Supply Co.
Morse Bros. Machy. & Sup. Co.
Simpson Co., A. H.
Westinghouse Elec. & Mfg. Co.

Mucking Machines, Mechanical

Lake Superior Loader Co.

Nodulizers, Ore

Allis-Chalmers Mfg. Co.

Office Supplies

Dixon Crucible Co., Joseph
Monroe Calculating Machine Co.

Oil and Grease Cups (see 'Lubricators')

Oil, Flotation

Barrett Co.
Florida Wood Products Co.
General Naval Stores
Pensacola Tar & Turpentine Co.

Ore-Buyers (see 'Metal Buyers and Dealers')

Ore Feeders

Buchanan Co., Inc., C. G.

Ore Testing Equipment

General Engineering Co.

Oxy-Acetylene Welding and Cutting Apparatus

Bullard, E. D.

Oxygen Apparatus

Bullard, E. D.
Siebe, Gorman Co., Ltd.

Packing

Diamond Rubber Co., Inc.
Goodrich Rubber Co., B. F.
New York Belting & Packing Co.
Pioneer Rubber Mills
Smooth-On Mfg. Co.
U. S. Rubber Co.

Paints, Metal Protective

Dixon Crucible Co., Joseph

Paints, Preservative

Dixon Crucible Co., Joseph

Pebbles

Atkins, Kroll & Co.
Hardinge Co.

Perforated Metals

Allis-Chalmers Mfg. Co.
Ludlow-Saylor Wire Co.
Meese & Gottfried Co.

Pipe Fittings

American Steel Foundries
Diamond Rubber Co., Inc.
Garratt & Co., W. T.
Goodrich Rubber Co., B. F.
Lunkenheimer Co., The
Merrill Co.
Pacific Pipe Co.
Pacific Tank & Pipe Co.
Powell Co., Wm.
Sacramento Pipe Works

Pipe, Cast Iron

Pacific Pipe Co.

Pipe, Riveted

American Spiral Pipe Works
Sacramento Pipe Works

Pipe, Standard Wrought

National Tube Co.
Pacific Pipe Co.

Pipe, Wood

National Tank & Pipe Co.
Pacific Tank & Pipe Co.
Redwood Mfrs. Co.

Placer Mining Machinery

Aldrich Pump Co.
American Spiral Pipe Works
Morse Bros. Machy. & Sup. Co.
New York Engineering Co.
Union Construction Co.
Yuba Mfg. Co.

Pneumatic Tools

Chicago Pneumatic Tool Co.
Ingersoll-Rand Co.
Sullivan Machinery Co.

Prospecting Supplies

Braun Corporation
Braun-Knecht-Heimann-Co.
Denver Fire Clay Co.
Dobbins Core Drill Co.
Longyear Co., E. J.
Mine & Smelter Supply Co.
New York Engineering Co.
Rix Compressed Air & Drill Co.
Union Construction Co.

ACIDS

FINE COAL

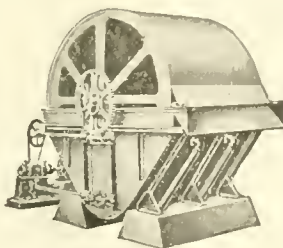
PAPER

GET IN STEP!

COMPETITION, the vanguard of lasting prosperity IS HERE, and operating costs MUST COME DOWN.

How can you reduce
labor costs without
reducing wages?

The "other fellow" has
learned how.



THE OLIVER

How can you make
a better and more
salable product?

Your competitor is
doing it now.

OLIVER FILTERS are the answer—automatic and efficient.

Ask the men who own them, operate them, and know them: the Operator whose work they simplify; the Superintendent whose mainstay they are; and the Owner whose dividends increase.

GET IN STEP!

Engineering advice on request. Laboratory service free.

Send for Bulletin No. 12-A

OLIVER CONTINUOUS FILTER CO.

SAN FRANCISCO
501 Market St.

LONDON, W.C.
11-13 Southampton Row

NEW YORK
1422-24 Aeolian Bldg.

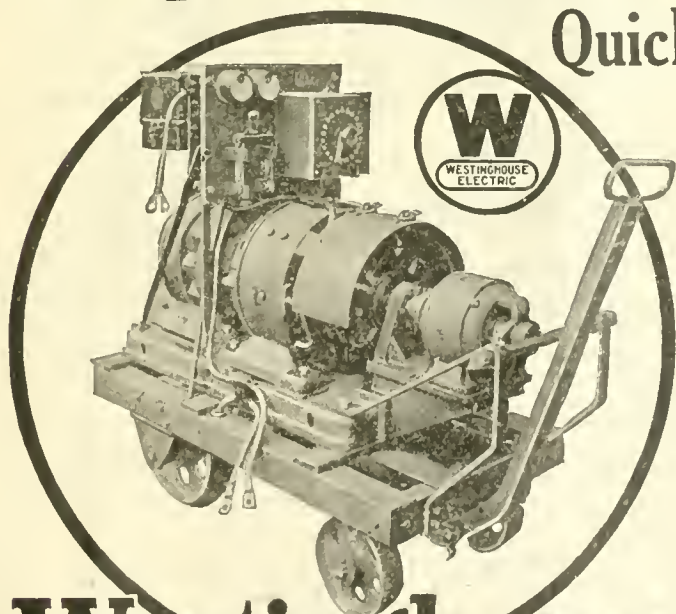
ORES

STARCH

ALKALIES

See our exhibit at the Seventh National Exposition of Chemical Industries 8th Coast Artillery Armory, New York, Week of September 12th

Keep Your Tonnage High With Quick Permanent Repair Work



Every breakdown on your property means less available equipment and less tonnage. Don't scrap the broken equipment or send it away to be repaired—weld it—right on the property and get it back in service in a few hours instead of many days.

The Westinghouse portable arc welder shown on the left, in the hands of an operator can save you thousands of dollars—by welding broken cars, car wheels, gears, shafts, pipe lines, and hundreds of other metal parts. Welding assures the permanency of the repair and keeps repair bills low.

Write for Bulletin 7149 today

Westinghouse Electric & Mfg. Co.
East Pittsburgh, Pa.

Offices in all Principal American Cities

Westinghouse

W Arc Welders W

THE - BUYER'S - GUIDE

Pulleys, Magnetic

Buchanan Co., Inc., C. G.
Dings Magnetic Separator Co.

Pulleys, Shafting and Hangers (see 'Transmission Machinery')

Pulverized Coal Installations

Fuller Lehigh Co.

Pumps, Air Lift

Aldrich Pump Co.
Chicago Pneumatic Tool Co.
Ingersoll Rand Co.
Prescott Co.
Traylor Eng. & Mfg. Co.

Pumps, Centrifugal

Aldrich Pump Co.
Atlas Chalmers Mfg. Co.
Byron Jackson Iron Works
Fairbanks, Morse & Co.
Freuer & Sons
Garrett & Co., W. T.
Hendrie & Bolthoff Mfg. & Sup. Co.
Ingersoll Rand Co.
Krogh Pump & Machinery Co.
Mine & Smelter Supply Co.
Morse Bros. Machy. & Sup. Co.
Oliver Continuous Filter Co.
Pacific Pipe Co.
Pelton Water Wheel Co.
Prescott Co.
Simpson Co., A. H.
Worthington Pump & Mach. Corp.
Yuba Mfg. Co.

Pumps, Reciprocating

Aldrich Pump Co.
Atlas Chalmers Mfg. Co.
Hendrie & Bolthoff Mfg. & Sup. Co.
Ingersoll-Rand Co.
Mine & Smelter Supply Co.
Morse Bros. Machy. & Sup. Co.
Prescott Co.
Traylor Eng. & Mfg. Co.
Worthington Pump & Mach. Corp.

Pumps, Vacuum

Chicago Pneumatic Tool Co.

Quicksilver

Atkins, Kroll & Co.
Braun Corporation, The
Braun-Knecht-Heimann-Co.
Bullard, E. D.
Denver Fire Clay Co.
Mine & Smelter Supply Co.

Roadbuilding Material

Koppel Industrial Car & Equip. Co.

Railway Supplies and Equipment

American Steel Foundries
Atlas Car & Mfg. Co.
Diamond Rubber Co., Inc.
General Electric Co.
Hickok & Hickok

Rock Drills

Chicago Pneumatic Tool Co.
General Electric Co.
Cochise Machine Co.

Roller Bearings

Hyatt Roller Bearing Co.

Rolls, Crushing

Atlas Car & Mfg. Co.
Bacon, Inc., Earle C.
Box Iron Works Co., Wm. A.
Buchanan Co., Inc., C. G.
Chalmers & Williams
Colorado Iron Works
Denver Engineering Works Co.
Fuller-Lehigh Co.
Mine & Smelter Supply Co.
Morse Bros. Machy. & Sup. Co.
Traylor Eng. & Mfg. Co.
Worthington Pump & Mach. Corp.

Roll Shells

Cambria Steel Co.

Rope, Wire

American Steel & Wire Co.
Broderick & Bascom Rope Co.
Denver Engineering Works Co.
Leschen & Sons Rope Co., A.
Morse & Gottfried Co.
Roebbing's Sons Co., John A.
Simpson Co., A. H.

Rubber Boots and Shoes

Goodrich Rubber Co., B. F.
U. S. Rubber Co.

Rubber Goods, Mechanical

New York Belting & Packing Co.

Safety Appliances

Bullard, E. D.
Siebe, Gorman Co., Ltd.

Samplers

Box Iron Works Co., Wm. A.
Braun Corporation
Braun-Knecht-Heimann-Co.
Colorado Iron Works
Denver Fire Clay Co.
Mine & Smelter Supply Co.
Morse Bros. Machy. & Sup. Co.
Traylor Eng. & Mfg. Co.

Saw Mill Machinery

Box Iron Works Co., Wm. A.
Morse & Gottfried Co.
Prescott Co.

Screens

Atlas Chalmers Mfg. Co.
American Steel Foundries
Box Iron Works Co., Wm. A.
Braun Corporation
Braun-Knecht-Heimann-Co.
Chalmers & Williams
Colorado Iron Works
Denver Engineering Works Co.
James Ore Concentrator Co.
Ludlow-Saylor Wire Co.
Morse & Gottfried Co.
Stumpson Equipment Co.
Traylor Eng. & Mfg. Co.
Tyler Co., W. S.

Screens, Mining, Etc.

Ludlow-Saylor Wire Co.
Tyler Co., W. S.

Screens, Revolving

Buchanan Co., Inc., C. G.

Screens, Rolled Slot

Ludlow-Saylor Wire Co.
Tyler Co., W. S.

Screens, Wire

Ludlow-Saylor Wire Co.
Tyler Co., W. S.

Separators

Buchanan Co., Inc., C. G.

Separators, Inclined Vibrating Screen

Tyler Co., W. S.

Shafting (see 'Transmission Machinery')

Shoes and Dies

Bethlehem Shipbuilding Corp., Ltd.
Denver Engineering Works

Shovels, Electric and Steam

Leschen & Sons Rope Co., A.
Thew Shovel Co.

Shovelling Machines

Lake Superior Loader Co.

Silica

Atkins, Kroll & Co.
Harrington Co.

Silica Brick

Harrison-Walker Refractories Co.

Smelters and Refiners

American Zinc, Lead & Smelt. Co.
Empire Zinc Co.
International Smelting Co.
U. S. Smelting, Ref. & Min. Co.
Wildberg Bros.

Smelting Machinery

Atlas Chalmers Mfg. Co.
Colorado Iron Works
Dwight & Lloyd Sintering Co.
Greenawalt Sintering Apparatus
Morse Bros. Machy. & Supply Co.
Traylor Eng. & Mfg. Co.
Worthington Pump & Mach. Corp.

Springs

American Spiral Pipe Works
American Steel Foundries
American Steel & Wire Co.

Steel, Drill

Cambria Steel Co.
Denver Rock Drill Mfg. Co.
Ingersoll-Rand Co.
Simpson Co., A. H.
Sullivan Machinery Co.

Steel, Tool

Cambria Steel Co.

Stretchers

Williams Improved Stretcher Co.

Surveying Instruments

Braun Corporation
Braun-Knecht-Heimann-Co.
Broderick & Bascom Rope Co.

Tanks, Steel

Box Iron Works Co., Wm. A.
Denver Engineering Works Co.
Ingersoll-Rand Co.
Simpson Co., A. H.

Tanks, Wood

Denver Engineering Works Co.
Morse Bros. Machy. & Supply Co.
National Tank & Pipe Co.
Pacific Tank & Pipe Co.
Redwood Mfrs. Co.

Tapes, Measuring

Lufkin Rule Co.

Testing Sieves and Testing Sieve Shakers

Tyler Co., W. S.

Thickeners, Pulp

Colorado Iron Works
Dorr Co.
National Tank & Pipe Co.
Oliver Continuous Filter Co.
Pacific Tank & Pipe Co.

Tires, Auto and Truck

Goodrich Rubber Co., B. F.

Tools, Blacksmith

Ingersoll-Rand Co.

Tractors

Yuba Mfg. Co.

Tramways, Aerial

American Steel & Wire Co.
Broderick & Bascom Rope Co.
Morse Bros. Machy. & Supply Co.
Roebbing's Sons Co., John A.
Simpson Co., A. H.

Transmission Machinery

Atlas Chalmers Mfg. Co.
Morse & Gottfried Co.
Prescott Co.

Trucks, Motor (see 'Motor Trucks')

Tube-Mills (see 'Mills')

Turbines, Hydraulic

Atlas Chalmers Mfg. Co.
Pelton Water Wheel Co.
Smith Co., S. Morgan

Turbines, Steam

Atlas Chalmers Mfg. Co.
General Electric Co.
Westinghouse Elec. & Mfg. Co.

Valves

Crane Co.
Lunkenheimer Co.
Merrill Co.
Powell Co., Wm.

Water Wheel, Impulse

Box Iron Works Co., Wm. A.
Morse Bros. Machy. & Supply Co.
Pelton Water Wheel Co.
Simpson Co., A. H.
Smith Co., S. Morgan

Well Drilling Machy. and Supplies

Union Construction Co.

Wheels, Car

American Steel Foundries
Atlas Car & Mfg. Co.
Fuller-Lehigh Co.
Hickok & Hickok

Whistles

Lunkenheimer Co.
Powell Co., Wm.

Wire

American Steel & Wire Co.
Broderick & Bascom Rope Co.
Morse & Gottfried Co.
Roebbing's Sons Co., John A.
Simpson Co., A. H.

Wire Cloth

Ludlow-Saylor Wire Co.
Tyler Co., W. S.

Wire, Insulated

Diamond Rubber Co., Inc.
General Electric Co.
Goodrich Rubber Co., B. F.
Roebbing's Sons Co., John A.

Zinc Boxes

Colorado Iron Works
Mine & Smelter Supply Co.
National Tank & Pipe Co.
Pacific Tank & Pipe Co.
Redwood Mfrs. Co.
Traylor Eng. & Mfg. Co.

Zinc Dust and Shavings

American Zinc, Lead & Smelt. Co.
Atkins, Kroll & Co.
Braun Corporation
Braun-Knecht-Heimann-Co.
Denver Fire Clay Co.
Merrill Co.
Mine & Smelter Supply Co.
Pacific Tank & Pipe Co.
U. S. Smelting, Ref. & Min. Co.

Manual of Industrial Chemistry

Edited by ALLEN ROGERS

3rd Edition, Revised and Enlarged

1232 Pages

377 Illustrations

Price \$7.50

A manual for the student and manufacturer. The purpose in preparing this book was to assemble the ideas of a large number of men who are recognized authorities in their respective lines and thus produce a volume which would represent modern American methods and progress.

Structural and Field Geology

By JAMES GIEKIE

Fourth Edition, Revised

154 Pages

159 Illustrations

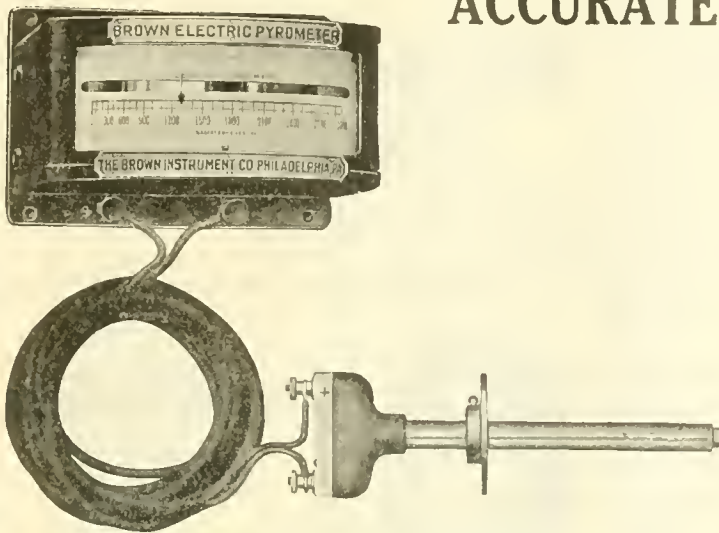
Price \$7.50

Written expressly for Students of Pure and Applied Science. The text of the fourth edition has been revised by Dr. Robert Campbell. Definitions have been modified in some cases in accordance with current usage and considerable alterations have been made in the detailed descriptions of rock-forming minerals and rocks.

ACCURATE TEMPERATURE DATA

—FOR—

**ORE ROASTING
BLAST FURNACES
GAS PLANTS
OIL REFINERIES
CEMENT PLANTS**



BROWN PYROMETERS

Can be located at any desired distance from the thermo-couples
due to their high resistance

We carry in stock a complete line of
BROWN PYROMETERS and
Accessories. An up to date Service
Department is maintained with
Pyrometer Experts at the disposal of
Brown Pyrometer users.

Write to us about your
Temperature Problems.

Scientific
Instruments

THE BRAUN CORPORATION

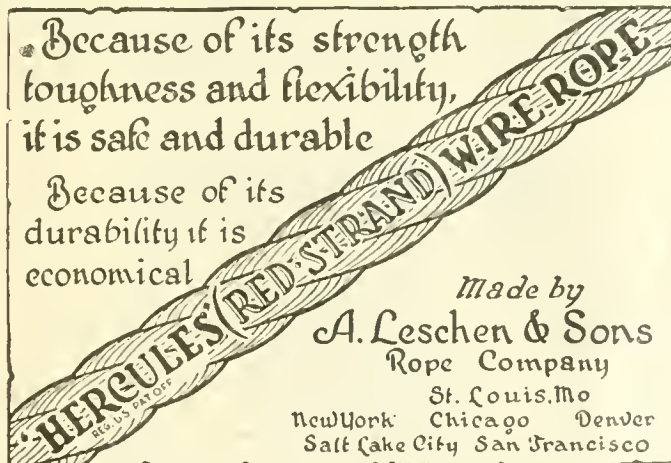
Scientific
Instruments

SAN FRANCISCO HOUSE
BRAUN-KNECHT-HEIMANN-CO.

LOS ANGELES, CALIFORNIA, U.S.A.

Because of its strength
toughness and flexibility,
it is safe and durable

Because of its
durability it is
economical



Made by
A. Leschen & Sons
Rope Company

St. Louis, Mo.
New York Chicago Denver
Salt Lake City San Francisco

The Greenawalt Sintering Apparatus and Process

John E. Greenawalt,
50 East 42nd Street
New York, N. Y.

W. E. Greenawalt,
85 South Sherman Street
Denver, Colorado

E. J. LONGYEAR COMPANY

EXPLORING ENGINEERS

DIAMOND DRILL CONTRACTORS AND
MANUFACTURERS

Examination and Exploration of Mineral
Lands

Shaft Sinking and Development

MINNEAPOLIS, MINNESOTA

MERCO NORDSTROM PLUG VALVE

"It Can't Stick—It Won't Leak"

The Lubrication Does It. End your valve troubles once and for all.
Indispensable on vacuum, air, gas, lime, acid and other solution lines.

Write for catalog and prices to

121 Second St. THE MERRILL CO. Monadnock Bldg.
SAN FRANCISCO CHICAGO

FRENIER'S SAND PUMP

THE MOST DURABLE FOR

SLIMES, TAILINGS, BATTERY SANDS, Etc.

AGENTS

Allis-Chalmers Co. Stearns-Roger Mfg. Co.
Milwaukee, Wis. Denver, Colo.
Harron, Rickard & McCone San Francisco
Frank R. Perrot, Sydney and Perth, Australia

FRENIER & SON, RUTLAND, Vt.



Jigs, Screens, Sand and Slime
Tables, Classifiers, Automatic
Ore Feeders, Etc.

Manufactured by

JAMES ORE CONCENTRATOR CO.
35 Runyon Street Newark, N. J.

United States Smelting, Refining & Mining Company

55 CONGRESS STREET, BOSTON, U. S. A.

BUYERS OF

Gold, Silver, Lead and Copper Ores Lead and Zinc
Concentrating Ores, Matte and Furnace Products

REFINERS OF

Lead Bullion.

PRODUCERS AND SELLERS OF

Gold, Silver, Lead, Copper, Zinc, Zinc Dust, Arsenic,
Insecticides, Fungicides, and Cadmium.

OPERATING OFFICES:

912 Newhouse Building, Salt Lake City, Utah; Ken-
nett, Cal.; Goldroad, Ariz.; Baxter Springs, Kansas;
120 Broadway, New York; Pachuca (Real del Monte
Co.), Mexico.

SELLING OFFICES: 120 BROADWAY, NEW YORK

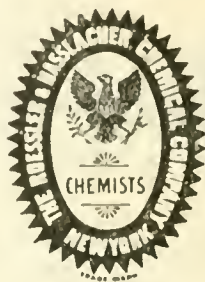
United States Smelting R. & M. Exploration Co.

For examination and purchase of Metal Mines, 55 Congress St.,
Boston, Mass. District Offices, 120 Broadway, N. Y.; 1501 Hobart
Bldg., San Francisco, Cal.; Newhouse Bldg., Salt Lake City, Utah

The Roessler & Hasslacher Chemical Company

709-717 6th Ave., cor. 41st St., NEW YORK, N.Y.

WORKS: PERTH AMBOY, N. J.



Cyanide Sodium

96-98%

(Cyanogen 51-52%)

"Cyanegg"

Sodium Cyanide 96-98% in egg form,
each egg weighing 1 ounce.
(Cyanogen 51-52%)

INTERNATIONAL SMELTING CO.

New York Office: 25 Broadway

Purchasers of

Gold, Silver, Copper, and Lead Ores

SMELTING WORKS: INTERNATIONAL, UTAH, and MIAMI, ARIZ.

REFINERIES:

International Lead Refining Company, East Chicago, Indiana
Raritan Copper Works, Perth Amboy, N. J.

ORE PURCHASING DEPARTMENT:

618 Kearns Building, Salt Lake City, Utah

American Smelters Securities Co.

(SELBY SMELTING WORKS)

Buyers of

GOLD and SILVER BULLION ORES, CONCENTRATES, ETC.

Consign all shipments to

American Smelters Securities Co.

SELBY, CAL.

Address correspondence to

MERCHANTS EXCHANGE BLDG., SAN FRANCISCO

American Zinc, Lead & Smelting Company

Purchasers of

ZINC AND LEAD ORES

Address: 1012 Pierce Building, St. Louis, Mo.

Exploration Department for the purchase of

METAL MINES AND METAL MINING COMPANIES

55 Congress St., Boston, Mass.

ATKINS KROLL & CO., San Francisco

IMPORT MERCHANTS

DANISH FLINT PEBBLES, SILEX LINING, CYANIDE
QUICKSILVER, MINING CANDLES, FIREBRICK
BORTS AND CARBONS, BLACKSMITH COAL, COKE
IMPORTED FUSE, SCHIEFELITE CONCENTRATES, 70%.
SUPERIOR QUALITY ZINC DUST

STOCKS CARRIED



DEISTER-OVERSTROM

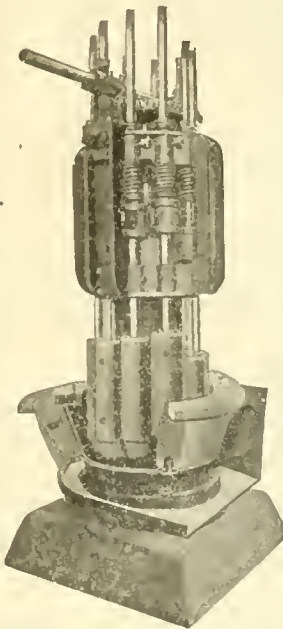
DIAGONAL DECK SAND AND SLIME TABLES

THE

DEISTER CONCENTRATOR COMPANY
FORT WAYNE, INDIANA

AWARDED GOLD MEDAL

At the Panama-Pacific Exposition

**STRAUB
STAMP
MILL**

AFTER ALL, there is nothing like a stamp mill for best results in amalgamating and concentrating the highest percentage of your gold and silver values.

And the STRAUB is the last word in stamp mills. It is the perfection of the old principle, with many new advantages and improvements over the old, heavy stamp mill.

A few of these are: Reduction of weight, and power and water required; less upkeep and delay for repairs; has screen all around mill, making good discharge; decreases sliming to a minimum; increases percentage of savings to a maximum; low cost of mill, transportation, and erection.

*Why not get the best
when it costs less?*

Straub Manufacturing Co.507 Chestnut Street
OAKLAND, CALIFORNIA**NO MATTER WHERE YOU ARE
WE CAN**

Save you time—All orders are shipped the same day they are received—thereby giving you the promptest service.

Save you money—We are sole distributors for many of our lines and large jobbers for all. This allows us to buy at very low prices and thus sell you at low figures.

Save you worry—In specializing on a few lines we guarantee that all your orders will be filled exactly as specified and filled intelligently.

THEREFORE

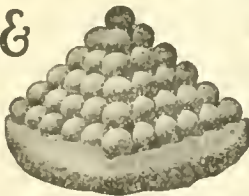
We solicit your orders for

**EVERYTHING IN ACETYLENE
AND EVERYTHING IN SAFETY****E. D. BULLARD**

268 Market St., San Francisco, Cal.

Duroloid**BALLS &****LINERS**

Write for
Booklet and
Prices



Los Angeles
Foundry Co.
2444 So. Alameda
Los Angeles, Cal.

ROEBLING**WIRE ROPE**

WELDING WIRE

WIRE ROPE FITTINGS

JOHN A. ROEBLING'S SONS CO. OF CALIFORNIA

624-646 Folsom Street, San Francisco

216 S. Alameda St., Los Angeles

900 First Ave., So., Seattle

14th and Lovejoy Sts., Portland, Ore.

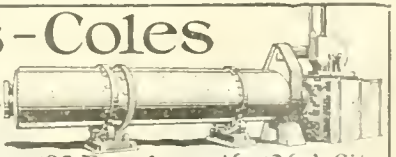
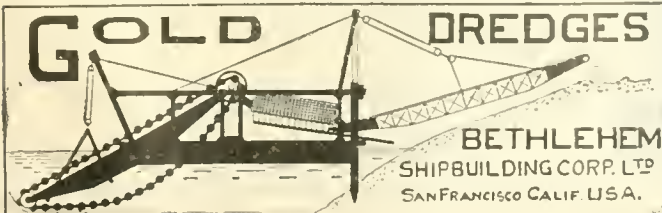
Harbison-Walker Refractories Company

MANUFACTURERS OF

High Grade Silica, Chrome,
Magnesia, and Fire Clay Brick,
Dead Burned Magnesite and Furnace Chrome,
Chrome Ore.

PITTSBURGH, PA.**Ruggles-Coles****DRYERS**

Ruggles-Coles
Engineering Company 120 Broadway New York City

**GOLD DREDGES**

BETHLEHEM
SHIPBUILDING CORP. LTD
SAN FRANCISCO CALIF. U.S.A.

UNIVERSAL CYANIDING MACHINE**TRENT**

AGITATORS
THICKENERS
REPLACERS

Catalog
on
Request

GOODWIN M. TRENT

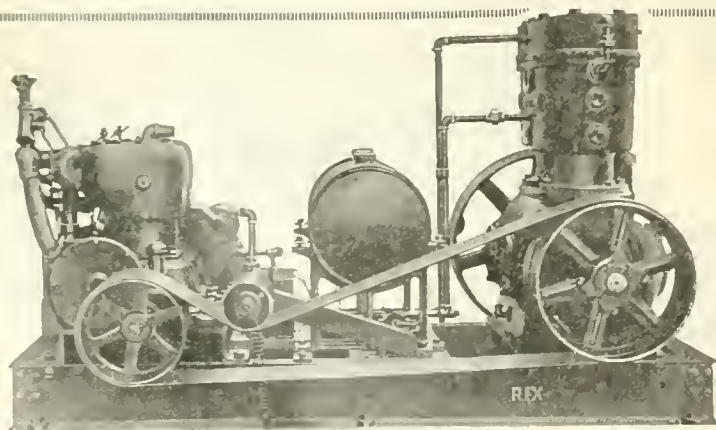
Sharon Bldg.

San Francisco, Calif.

ALPHABETICAL INDEX TO ADVERTISERS

- Dash Indicates Every Other Week or Monthly Advertisement -

	Page		Page		Page
Aldrich Pump Co., A. S. Low, Pa.	—	Fairbanks, Morse & Co., Chicago	—	Oliver Continuous Filter Co., San Francisco	37
Allen Chambers Mfg. Co., Milwaukee, Wis.	4	Fawcett Machine Co., Pittsburgh, Pa.	31	Opportunity Pages	21-25
American Cyanamid Co., New York	—	Filter Fabrics Co., Salt Lake City, Utah	—	Ottumwa Iron Works, Ottumwa, Iowa	33
American Smelters Supply Co., San Francisco	10	Flexible Steel Lacing Co., Chicago	1a		
American Steel Pipe Works, Chicago	—	Florida Wood Products Co., Jacksonville, Fla.	35		
American Steel & Wire Co., Chicago	33	Frederic & Son, Rutland, Vt.	30	Pacific Pipe Co., San Francisco	25
American Steel Foundries, Chicago	—	Fuller Lehigh Co., Fullerton, Pa.	—	Pacific Tank & Pipe Co., San Francisco	—
American Zinc Lead & Smelting Co., St. Louis	40			Pelton Water Wheel Co., San Francisco	—
Ames Co., W. R., San Francisco	3a	Garratt & Co., W. T., San Francisco	—	Pensacola Tar & Turpentine Co., Gulf Point, Fla.	35
Assayers, Chemists and Ore Testing Works	29	General Electric Co., Schenectady, N. Y.	—	Photostat Corp., Providence, R. I.	—
Atlas Krieger & Co., San Francisco	40	General Naval Stores, New York	35	Pioneer Rubber Mills, San Francisco	—
Atlas Car & Mfg. Co., Cleveland, Ohio	31	Greenvault Sintering Apparatus & Process, New York	39	Positions Available	25
				Positions Wanted	25
Bacon Iron Works, Wm., Denver, Colo.	18	Harrison Walker Retractories Co., Pittsburgh	41	Powell Co., Wm., Cincinnati, Ohio	—
Barnett Co., The, New York	35	Hardinge Co., New York	2	Prescott Co., The, Menominee, Mich.	—
Bartley Cr. Co., Jonathan Trenton, N. J.	—	Hendrie & Bolthoff Mfg. & Supply Co., Denver	—	Trust O'Leary Co., New York	—
Bethlehem Steel Building Corp., San Francisco	41	Hercules Powder Co., Wilmington, Del.	—	Professional Directory	26-30
Bessemer Mill & Towne, San Francisco	—	Hickok & Hickok, San Francisco	17		
Binks, T. H., Trenton, N. J.	25-38	Holt Mfg. Co., Peoria, Ill.	—	Redwood Mfrs. Co., San Francisco	—
Box Iron Works, Wm., Denver, Colo.	18	Hyatt Roller Bearings Co., New York	—	Rix Compressed Air & Drill Co., San Francisco	42
Braden Corporation, The, Los Angeles, Cal.	39			Roebuck's Sons Co., John A., Trenton, N. J.	41
Brayn Kieselheimann Co., San Francisco	30	Ingersoll-Rand Co., New York	10-11	Roesler & Hasselbacher Chem. Co., New York	40
Brodrick & Bascom Rope Co., St. Louis	—	International Smelting Co., New York	40	Ruggles Coles Engineering Co., New York	41
Bryanham Co., C. G., New York	35				
Bullard E. D., San Francisco	41	Jackson Compressor Co., Denver	—	Sacramento Pipe Works, Sacramento, Cal.	—
Bush Silver Bros., St. Louis, Mo.	—	James Ore Concentrator Co., Newark, N. J.	39	San Francisco Plating Works, San Francisco	—
Business Men's Clearing House, Denver	—			Siebs, Gorman & Co., Ltd., Chicago	—
Buyers' Guide	34-36-38	Koppel Industrial Car & Equip. Co., Pittsburgh	25	Simpson Co., A. H., San Francisco	—
Byron Jackson Iron Works, San Francisco	—	Krogh Pump & Mach. Co., San Francisco	33	Smith Co., S. Morgan, York, Pa.	—
				Smooth On Mfg. Co., Jersey City, N. J.	—
Cañon Co., Justinian, San Francisco	35	Lake Superior Loader Co., Duluth, Minn.	—	Stearns-Roger Mfg. Co., Denver, Colo.	24
Calkins Co., Los Angeles, Cal.	35	Lane Mill & Mach. Co., Los Angeles, Cal.	—	Stimpson Equipment Co., Salt Lake City	31
Cambria Steel Co., Philadelphia	18	Latham, Mare L., Angeles Camp, Cal.	24	Strahl Mfg. Co., Oakland, Cal.	41
Cement Gun Co., Cornwells Heights, Pa.	—	Leffel & Co., James, Springfield, Ohio	—	Sullivan Machinery Co., Chicago	46-25
Chambers & Williams, Chicago Heights, Ill.	14	Leschen & Sons Rope Co., St. Louis, Mo.	39		
Chicago Pneumatic Tool Co., New York	20	Lidgerwood Mfg. Co., St. Louis, Mo.	31	Thompson Balance Co., Denver	—
Cleveland Rock Drill Co., Cleveland, Ohio	43	Linde Air Products Co., New York	—	Thew Shovel Co., Lorain, Ohio	—
Cochise Machine Co., Los Angeles, Cal.	18	Longyear Co., E. J., Minneapolis, Minn.	39	Traylor Eng. & Mfg. Co., Allentown, Pa.	9
Colorado Iron Works Co., Denver	43	Los Angeles Foundry Co., Los Angeles, Cal.	41	Trent, Goodwin M., San Francisco	44
Craze Co., Chicago, Ill.	Front Cover	Ludlow-Saylor Wire Co., St. Louis, Mo.	5	Tyler, W. S., Cleveland, Ohio	23
		Lufkin Rule Co., Saginaw, Mich.	24		
Deister Concentrator Co., Fort Wayne, Ind.	40	Lunkenheimer Co., The, Cincinnati, Ohio	8	Union Construction Co., San Francisco	25
Deister Machine Co., Fort Wayne, Ind.	14	Main Belting Co., Philadelphia, Pa.	19	United Filters Corp., Salt Lake City, Utah	—
Denver Engineering Works, Denver	—	Meese & Gottfried Co., San Francisco	44	U. S. Iron Works, Seattle, Wash.	24
Denver Fire Clay Co., Denver	—	Merrill Co., San Francisco	39	U. S. Rubber Co., New York	—
Denver Rock Drill Mfg. Co., Denver	31	Midvale Steel & Ordnance Co., Philadelphia	18	U. S. Smelting, Refining & Mining Co., Boston	40
Detroit Graphite Co., Detroit, Mich.	—	Mine & Smelter Supply Co., New York	22		
Dixon Crucible Co., Joseph, Jersey City, N. J.	—	Monroe Calculating Machine Co., New York	7	Western Wheeled Scraper Co., Aurora, Ill.	—
Dobbins Core Drill Co., New York	—	Morse Bros. Mach. & Supply Co., Denver	24	Western Wood Pipe Publicity Bureau, Seattle	12-13
Dorr Company, The, Denver	31	Nashville Industrial Corp., Old Hickory, Tenn.	—	Westinghouse Elec. & Mfg. Co., East Pittsburgh, Pa.	37
Du Pont de Nemours & Co., Wilmington, Del.	—	National Tank & Pipe Co., Portland, Ore.	31	Wildberg Bros., San Francisco	—
Dwight & Lloyd Sintering Co., New York	25	National Tube Co., Pittsburgh, Pa.	—	Williams Imp. Stretcher Co., Wheeling, W. Va.	—
		Nevada Eng. & Supply Co., Reno, Nev.	—	Worthington Pump & Mach. Corp., New York	—
Edison Storage Battery Co., Orange, N. J.	—	New York Belting & Packing Co., New York	—		
Elmer, H. N., Chicago	—	New York Engineering Co., New York	24	Yuba Manufacturing Co., San Francisco	33
Electric Storage Battery Co., Philadelphia	—	Nordberg Mfg. Co., Milwaukee, Wis.	—		
Elsoi Concentrating Co., Los Angeles, Cal.	—	Nuttall Co., R. D., Pittsburgh, Pa.	—		



No. 60 Complete Outfit. Heaviest piece weighs but 250 lbs.

WE SPECIALIZE

on prospecting outfits. Made in many different styles and sizes to meet every requirement. Send for our new catalog P.C.-1 just issued.

RIX COMPRESSED AIR AND DRILL CO.

San Francisco and Los Angeles

